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...rical ...

WHAT'S AHEAD IN

LIGHTING

{ ... opinions on nation-wide survey on ... post-war trends in lighting covering fifty-four questions on such subjects as . . . Higher levels . . . Glare control . . . Higher voltages . . . Effect of dimout . . . In-built lighting . . . Architectural coordination . . . Fluorescent for homes . . . Market analyses . . . Street lighting . . . Sales . . . Education.

MEASURE *All* LIGHT SOURCES *Direct*

. . . . . *without Correction factors !*

✓ FLUORESCENT
✓ INCANDESCENT
✓ SODIUM VAPOR
✓ NEON, ETC.

WESTON

DIRECT-READING ILLUMINATION METERS

Model 703 Sightmeter —equipped with the stable all-glass WESTON perfected VISCOR filter.

Model 603 WESTON Illumination Meter (VISCOR filtered)

Model 614 WESTON Illumination Meter (VISCOR filtered)

Whenever you see a lighting man taking a *direct* measurement from a flourescent or other special light source . . . conveniently and quickly, and without consulting correction tables . . . you can be reasonably sure the instrument is a WESTON Illumination Meter. For, all the WESTON models illustrated now are equipped to provide *direct measurement* of the illumination from *any* light source . . . regardless of the color composition.

The development of these versatile instruments stems from WESTON'S time honored policy of *pioneering* in the development of *new* measurement tools . . . then, *continuing* the research and development to constantly provide the utmost in convenience and dependability for the measurment need.

Complete information on WESTON instruments for convenient light measurement, as well as for efficient, automatic control of lighting, will gladly be sent on request. Weston Electrical Instrument Corporation, 578 Frelinghuysen Avenue, Newark 5, New Jersey.

Laboratory Standards . . . Precision DC and AC Portables . . . Instrument Transfomers . . . Sensitive Relays . . . DC, AC, and Thermo Switchboard and Panel Instruments.

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Specialized Test Equipment . . . Light Measurement and Control Devices . . . Exposure Meters...Aircraft Instruments... Electric Tachometers...Dial Thermometers.

FOR OVER 55 YEARS LEADERS IN ELECTRICAL MEASURING INSTRUMENTS

Electrical World

July 24, 1943 — Vol. 120, No. 4

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From .....

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To .....

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Signed .....

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To assist in conserving rubber...

HAZAPAK RUBBERLESS WIRE

• SAVES RUBBER • SAVES TIN
• SAVES CRITICAL SYNTHETICS

HAZAPAK Rubberless Building Wire is approved by the Underwriters' Laboratories, Inc., under the provisions of Interim Amendments 44 and 69 of the National Electrical Code.

In this new rubberless building wire, in place of the familiar rubber insulation, there are two separate materials – (1) a thin layer of Kodapak (cellulose acetate butyrate)—a pure insulating material—covering the copper conductor, over which is wrapped—(2) a compacted cushion of crumpled moisture-proofed kraft paper for mechanical protection.

An overall covering of cotton yarn, saturated and color-coated to make it moisture-proof and flame-resistant, provides a finished wire which has the same appearance and diameter as rubber-insulated building wire.

There are two types of Hazapak Rubberless Wire, i.e.: Type EG (Emergency Grounded) and Type EI (Emergency Insulation).

Emergency Grounded Wire, Type EG, is the Underwriters' Laboratories designation for "wire of a type especially approved" in open wiring; in concealed knob and tube work; in non-metallic sheathed cable and as the grounded wire in any of the wiring systems covered by Articles 320 to 364 of the 1940 N.E.C. as provided in Interim Amendment 44. It is used as the white grounded conductor in assemblies such as Hazardex non-metallic sheathed cable and multiple-conductor lead-encased cables. Hazapak Rubberless Wire, Type EG, is always finished white and carries no surface markings. An attached tag indicates that it is to be used only on grounded circuits.

Emergency Insulation Wire, Type EI, as defined in Interim Amendment No. 69 of the 1940 N.E.C., may be used as the ungrounded conductor for non-metallic sheathed cable run exposed, or for open wiring on insulators, under the following conditions: 1. In dry locations only; 2. For voltages not exceeding 600; 3. If there are more than four conductors larger than No. 10 in an outlet or junction box, or in a cabinet or cutout box, the conductors must be individually wrapped with non-combustible, insulating tape. Type EI conductors should not be used in any hazardous location, except as provided for open work in Section 5075. In damp and wet locations, EI may be used with lead covering, Type EIL, in accordance with Section 3035. Type EI, as distinguished from Type EG, is surface marked and measured every two feet the same as rubber-insulated building wire. It is produced in standard building wire colors: black, red, green, yellow and blue. Underwriters' Laboratories approval labels marked "Type EI Building Wire" are attached to each coil or reel.

In the move to conserve rubber, the Civil Aeronautics Authority, Spec. 612 authorizes the use of wire such as Hazapak Rubberless for airport wiring, in ducts or for installation directly in the soil; the Federal Works Agency, Public Buildings Administration in its Suggested Specifications to Architects recommends the use of non-rubber insulated wire like Hazapak Rubberless under certain conditions; and specifications issued by office of Chief of Engineers, War Dept., Construction Div. for Theatre of Operations (Modified) and Mobilization Construction, Section 34 Interior Electrical Works, permit the use of Hazapak Rubberless Wire.

Our sales engineers will be glad to give you further details about Hazapak Rubberless Wire, samples, deliveries, etc., or ask your wholesaler for further information about Hazapak.

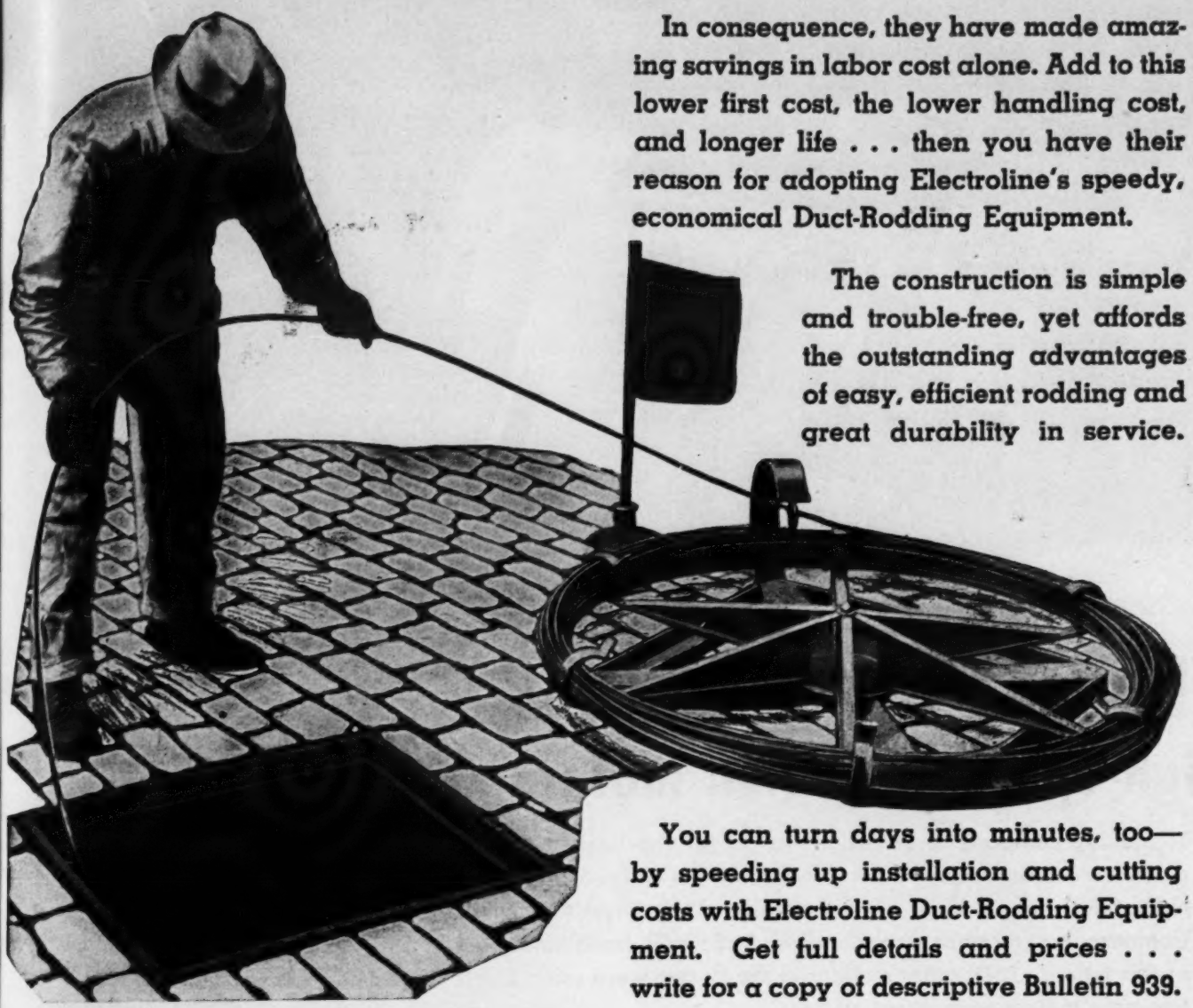
HAZARD
INSULATED WIRE WORKS
DIVISION OF THE OKONITE COMPANY
Works: Wilkes-Barre, Pennsylvania • Offices in Principal Cities

ARMY E NAVY

UTILITIES have found that one gang, with Electroline Steel Duct-Rodding Equipment, can make a half-hour job out of one that formerly took two gangs two weeks with old-style equipment!

In consequence, they have made amazing savings in labor cost alone. Add to this lower first cost, the lower handling cost, and longer life . . . then you have their reason for adopting Electroline's speedy, economical Duct-Rodding Equipment.

The construction is simple and trouble-free, yet affords the outstanding advantages of easy, efficient rodding and great durability in service.



You can turn days into minutes, too—by speeding up installation and cutting costs with Electroline Duct-Rodding Equipment. Get full details and prices . . . write for a copy of descriptive Bulletin 939.

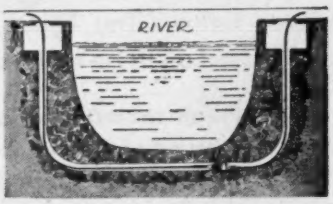
Thirty minutes or two weeks ?

Pick-up and Leader fittings meeting.

Right, Electroline Steel Rodding Equipment feeds easily around the bends.

Below, Leader locked in Pick-up for either push or pull.

PATENT APPLIED FOR

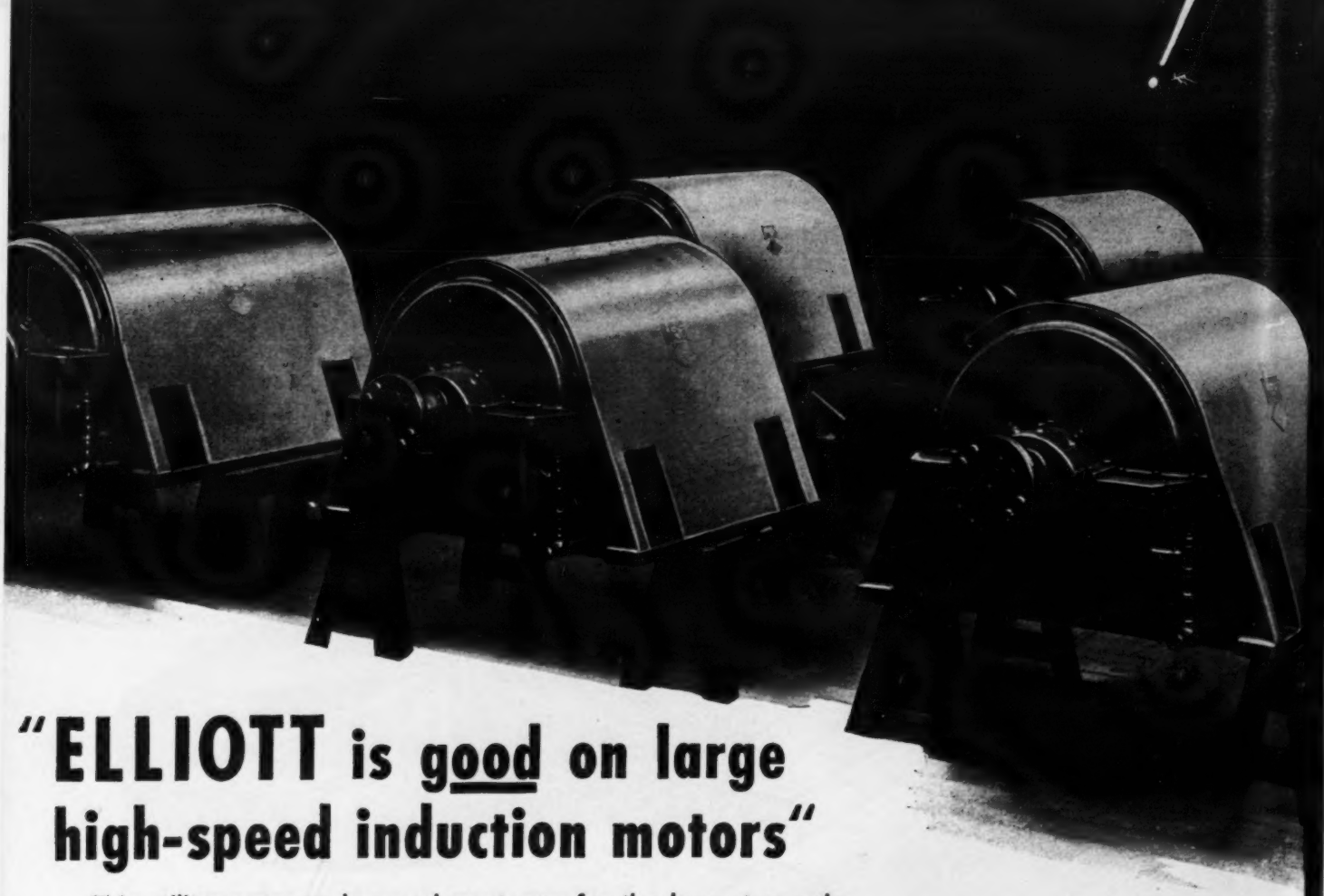


Electroline Company

4121 SOUTH LASALLE STREET

CHICAGO, ILLINOIS

Six beauties ready for shipment to a utility plant extension



"ELLIOTT is good on large high-speed induction motors"

This utility company knew where to go for the large two-pole induction motors required for driving the boiler-feed and other high-speed pumps for a plant extension. They knew that Elliott Company has superior experience and ability in building motors of this type. In fact, other stations in the system were using Elliott two-pole motors with great success.

The photograph shows six Elliott two-pole squirrel-cage induction motors, three 600-hp. and three 1000-hp. The motors are of the splash-proof type with bracket type bearings, pressure lubricated. Cooling air comes in around the bracket bearing and leaves below. The Elliott patented "diamond cage" construction is used on these motors to give high starting torque.

Elliott motors of this type are arranged for pressure lubrication, which in the ones illustrated will be supplied by the lubrication system of the pumps which the motors drive. Such motors can be furnished with complete built-in lubricating system. Stator frames are cast or welded steel, as desired. Large ventilating channels and ducts in shell and stator core insure cool, quiet operation. Structural design provides unusually high strength and rigidity at high speeds. Descriptive bulletin on request.

L-737

The Army-Navy "E" has been awarded to both the Jeannette and the Ridgway plants of Elliott Company.

ELLIOTT COMPANY

Electric Power Dept.

RIDGWAY, PA.

DISTRICT OFFICES IN PRINCIPAL CIT

CHECK the FACTS

METAL ENCLOSED EXCITER BUS increases generating station reliability.

1. Completely enclosed in grounded metal housing.
2. Protected against dust, dirt, moisture and accidental short circuits.
3. Safe—no hazards to personnel.
4. Compact.

R&IE ENCLOSED BUS

250 Volt D. C., 1500 Ampere Main Exciter bus for generator station—shown with and without metal housing covers.

The Check list

CONDUCTOR SUPPORT CLAMPS AND FITTIN

DISCONNECTING SWITCH INDOOR AND OUTDOOR

AIR BREAK SWITCH

INTERRUPTER SWITCH

CUTOUTS AND THERMO-RUPTERS

SWITCH OPERATIN MECHANISMS

SUBSTATIONS

OPEN OR ENCLOSED ISOLATED PHASE HEAVY DUTY BUSE

KIRK INTERLOCK SYSTEMS

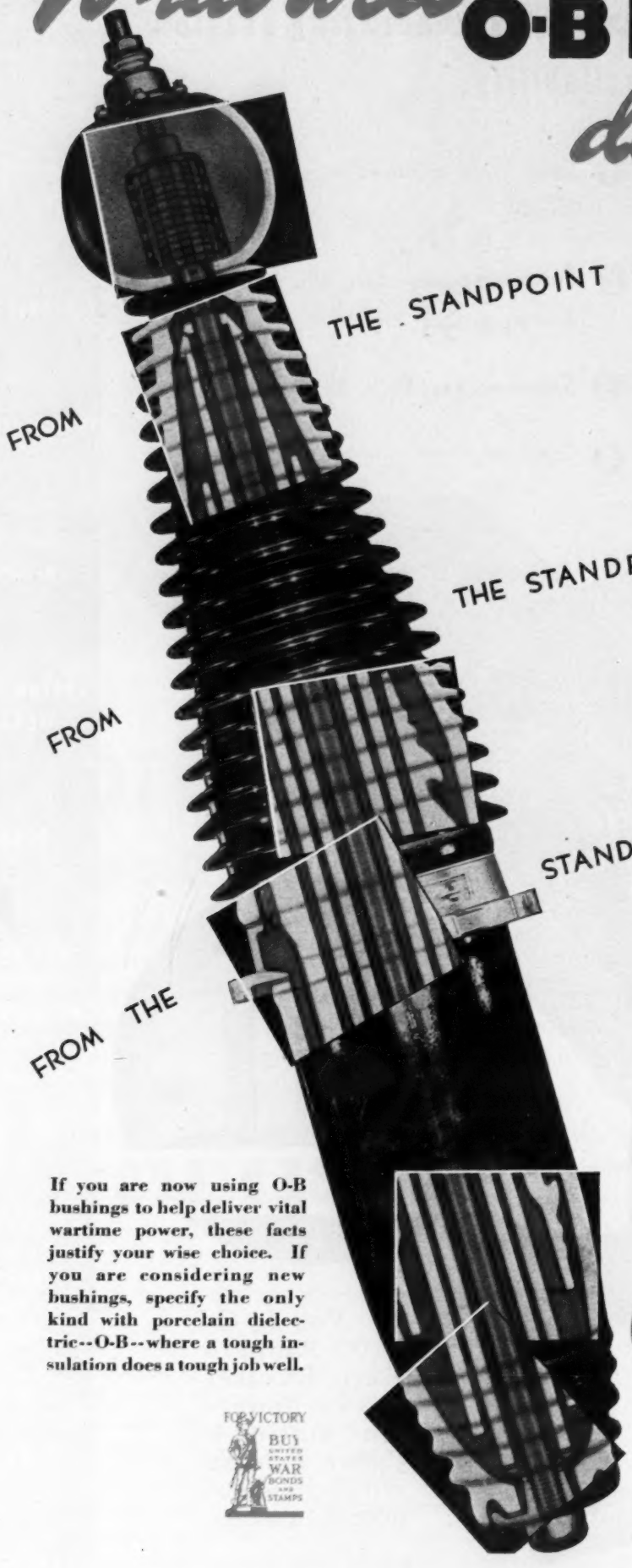
AUTOMATIC SECTIONALIZING EQUIPMENT

METAL CUBICLES

TESTING DEVICES

AILWAY AND INDUSTRIAL ENGINEERING CO., GREENSB URG, PA.

What will O-B BUSHINGS deliver?



FROM THE STANDPOINT OF **SERVICE ?**

Every O-B bushing will operate continuously at its full name-plate rating and will handle overloads without break-down or progressive deterioration. The internal porcelain dielectric cannot char or burn; absorbs absolutely no moisture; and its performance as an insulation is not dependent upon the exact condition of the oil.

FROM THE STANDPOINT OF **TIME ?**

Never in all recorded history has a piece of porcelain or its related materials been known to decompose or change in any of its physical characteristics. The porcelain in O-B bushings is good to start with, and stays that way! It is a stable insulation. It assures you of consistent performance.

FROM THE STANDPOINT OF **MAINTENANCE ?**

Your O-B bushings are something to forget--except when you want more good bushings. Porcelain insulation requires no periodic inspection or testing because it is unchangeable. Air, light, and moisture are totally excluded from the oil. The problem of oil leakage has been effectively met by O-B's compression spring assembly that also relieves all porcelain parts of destructive strains. Visual inspection tells you all you want to know about O-B bushings.

If you are now using O-B bushings to help deliver vital wartime power, these facts justify your wise choice. If you are considering new bushings, specify the only kind with porcelain dielectric--O-B--where a tough insulation does a tough job well.

Ohio Brass

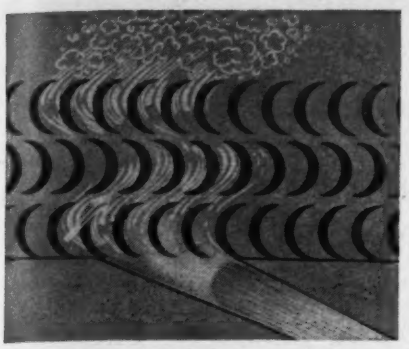
MANSFIELD, OHIO

CANADIAN OHIO BRASS COMPANY, LTD.,
NIAGARA FALLS, ONTARIO

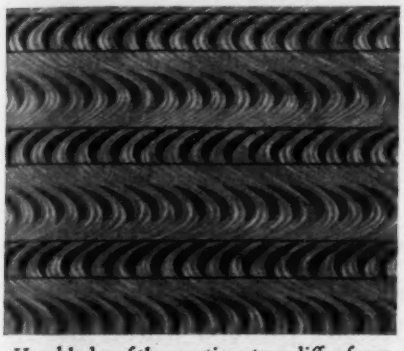
2411-H

New Movie Describes Steam Turbine Operation...

A few of the many details this film reveals—



How steam ejected from nozzles upon blades of the impulse stage drives the spindle to which they are fastened.



How blades of the reaction stage differ from those of the impulse stage, and why action of steam upon them makes them move.

"MAGIC OF STEAM" TELLS GRAPHIC STORY OF TURBINE THEORY AND PRINCIPLES

TO TRAIN new war workers in vital power plants . . . to instruct student engineers . . . to educate powerhouse operators and maintenance men — this dynamic new sound film has been prepared for your use!

By means of simplified, animated drawings, the complicated mechanics of the steam turbine have been brought to life on the screen. The camera takes you through the interior of the turbine chamber from end to end, shows you an inside picture of the governor system, blading, bearings, and lubrication system in actual operation — while the voice explains the construction and movement of each working part.

No advertising appears in this film. It has been produced by Allis-Chalmers for the use of men in government and industry to increase understanding and appreciation of the essential machine that keeps America's war production rising, and the propellers of our merchant and fighting ships turning.

AVAILABLE FOR FREE LOAN OR PURCHASE →

16 millimeter prints of this film are available to all who wish to borrow them for projection purposes. The film runs for approximately 18 minutes, and can be used on sound projectors only. If you want to see this important new film, just fill in and mail the coupon. We will do our best to give you prompt service.

If you want this film for permanent use, as an addition to your library, you may purchase it at cost for $31.00. Send your requests for loan or purchase to Allis-Chalmers Mfg. Co., Milwaukee, Wisconsin.

A 1593

ALLIS-CHALMERS MFG. CO.
Milwaukee, Wisconsin

Gentlemen:

☐ I would like to have one 16mm. print of your new sound movie, "The Magic of Steam" for showing before..... on .....1943.

☐ I would like to purchase.....prints of "The Magic of Steam" on a cost basis at $31.00 each.

Name.....

Position.....

Organization.....

Street Address.....

City & State.....

ALLIS-CHALMERS

VICTORY GARDENS AND VICTORY CABLES

Food supply and distribution have become enough of a problem so that everyone who can do so is asked to plant a "Victory Garden" and do a little toward increasing our available supply of food. At the same time, we are warned against wasteful use of seed and fertilizer due to lack of knowledge or skill. In other words, if we are not likely to get reasonable returns from the seed, fertilizer and labor, it is better to leave gardening to those who may get better results.

Similar conditions exist in the wire and cable industry. Cable engineering and manufacturing is a task for those with manufacturing skill and technical background. There is need for more and better insulated wires and cables for electrical transmission but the materials from which to make them are limited in quantity and can best be used by those who have the "know how" based on long experience.

Here at Simplex we have devoted nearly sixty years exclusively to the study and manufacture of insulated wires and cables. We have one objective and only one—to make better cables and do it more efficiently. Through study and experience we have developed skill which enables us to make the most of the limited materials now obtainable. Simplex wires and cables—now available only for high priority war work—meet all conservation regulations yet still retain those qualities that assure satisfactory service. Improvements that cannot be disclosed now will make Simplex wires and cables better than ever after the war.

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge, Mass.

Simplex

WIRES and CABLES

Pick the Best a-c Welder!

Today all transformer welders are not alike! Compare . . . and you'll find that one welder—the new Allis-Chalmers Ampac "200"—gives you far more in operating ease, power savings, low upkeep, versatility . . . and in faster and better welding!

Compare 4 leading types of Transformer Welder in their Use of 11 Important Features . . .

IMPORTANT FEATURES	HOW THEY BENEFIT YOU	AMPAC "200" (Integrated moving core type)	WELDER "B" (Moving coil type)	WELDER "C" (Moving core type)	WELDER "D" (Shunt type, moving core)
1 No arc blow to slow down welding.	Steady arc makes sound, uniform welds. You can weld in corners and grooves easily. Production is speeded.	YES	YES	YES	YES
2 Low striking voltage at high amperage.	Saves power for you. No need for high voltage at high currents. Raises power factor — cuts power input.	YES (65 volts)	NO (75 volts)	NO (75 volts)	NO (70 volts)
3 High striking voltage at low amperage.	Strikes arc fast. Gives you high, yet safe voltage necessary. Makes a-c welding easy at low currents.	YES (78 volts)	NO (72 volts)	NO (75 volts)	NO (75 volts)
4 Takes less than 300 sq. in. floor space.	Small size saves valuable space on crowded shop floors . . . makes it easier for you to move and handle the unit.	YES (281 sq. in.)	NO (351 sq. in.)	NO (396 sq. in.)	YES (288 sq. in.)
5 Contains less than 5 wearing parts.	Cuts maintenance to simple lubrication twice a year. Less chance for wear means longer service, lower upkeep.	YES (4 parts)	NO (6 or more)	NO (6 or more)	NO (6 or more)
6 Low original cost (no rotating element).	Simpler construction of a-c welder cuts purchase price to around 65% of what you would pay for a d-c welder!	YES	YES	YES	YES
7 Wide welding range of over 200 amperes.	You can weld thin sheets . . . yet have capacity for heavy plates, too. You can use rods from 1/16" to 1/4" in size!	YES (220 amp.)	YES (215 amp.)	NO (195 amp.)	NO (195 amp.)
8 Reconnectable for 220-440 & 208 v., 60 cycle.	Gives you full capacity at low voltages where lines are long and isolated. Can be used on *any* standard a-c voltage!	YES	NO (220 or 440)	NO (220-440 only)	NO (220-440 only)
9 Over 85% efficiency at normal loads.	You enjoy *full* benefits of a-c welding: lower power loss, high power factor, lower operating costs!	YES	NO	YES	YES
10 All settings within six control turns.	Saves welding time. Welder can make simple adjustment from high to low amperage current quickly and easily.	YES (6 turns)	NO (50 turns)	NO (30 turns)	NO (15 turns)
11 Movement of variable part 2" or less.	Cuts wear and maintenance to a minimum. Reduces hum and vibration Contributes to trouble-free operation.	YES (1 inch)	NO (9 inches)	NO (6 inches)	YES (2 inches)
		11	3	3	5
		Ampac "200"	Welder "B"	Welder "C"	Welder "D"

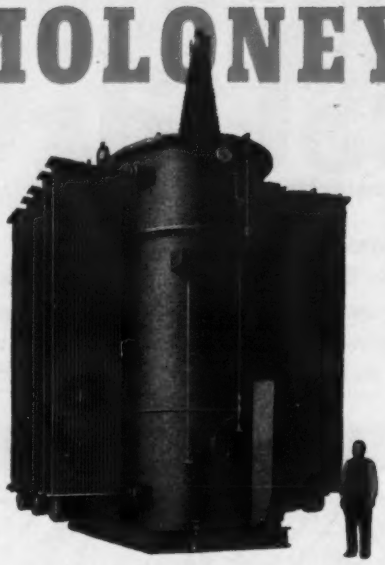
Only Ampac gives you all 11 . . . TOTALS

ALLIS-CHALMERS AMPAC "200"

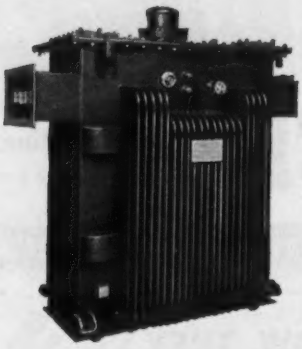
WRITE ALLIS-CHALMERS, MILWAUKEE, WIS., FOR COMPLETE INFORMATION

A1621

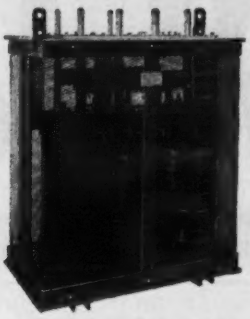
MOLONEY TRANSFORMERS



Moloney Power Transformer. Transformer pictured above is rated 25,000 Kva, 161,000Y to 13,200 volts. These transformers can be supplied in any capacity or voltage desired.



Moloney Askarel (non-inflammable liquid cooled) Transformer. For indoor installation at load centers without the use of fire-proof vaults. Available in all Kva and voltage ratings.



Moloney Air-Cooled Transformer with Class B insulation. For indoor installation at load centers without the use of fire-proof vaults. Available in voltages up to 13,800 volts and in capacities of 150 Kva and larger.

One of these MOLONEY transformers will meet your requirements . . .

Moloney manufactures transformers for all types of installations. If transformers of standard design do not fill your needs, our experienced engineering staff can design transformers which will exactly fit your requirements.

Disconnect switches, oil-fused cutouts, terminal boxes with potheads, forced-air-cooling, secondary air circuit breakers and many other features can be supplied on Moloney transformers.

Quick shipment can be effected whether the transformers are of standard or special design. Your inquiries will be given prompt attention.

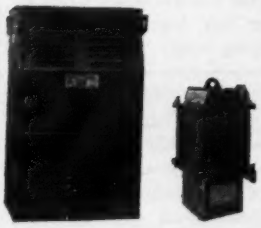
MOLONEY ELECTRIC COMPANY
ST. LOUIS, U. S. A.

Moloney Transformers for every purpose

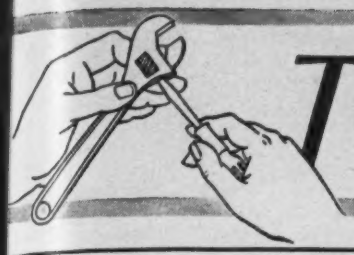
- Power Transformers
- Unit Substations
- Conventional Distribution Transformers
- Completely Self-Protected (CSP) Transformers
- Load Center Transformers
- Askarel (non-inflammable liquid) Cooled Transformers
- Air-cooled (Class A and Class B insulated) Transformers
- Constant Current Street Lighting Transformers
- Vault Type Transformers
- Submersible Type Transformers
- Furnace Transformers
- Shipboard Transformers
- Industrial Transformers
- Network Transformers

Moloney Conventional Distribution Transformer, oil-cooled, for outdoor pole or platform mounting. Sizes 1½ Kva to 500 Kva. Voltages up to 66,000 volts. Illustration typical of sizes 75 and 100 Kva, 7200 to 120/240 volts.

Moloney Completely Self-Protected Transformer, oil-cooled, equipped with built-in lightning and secondary overload protection. Sizes 1½ to 50 Kva. Voltages 2400 to 13,800 volts. Illustration typical of sizes 1½ to 25 Kva, 7200 to 120/240 volts.



Moloney General Purpose Air-Cooled Transformers with Class A insulation. For industrial use to serve lighting and small power loads. Left illustration typical of sizes 15 to 50 Kva. Right illustration typical of sizes 1 Kva to 10 Kva. Voltages 600, 480 or 240 to 120/240 volts.



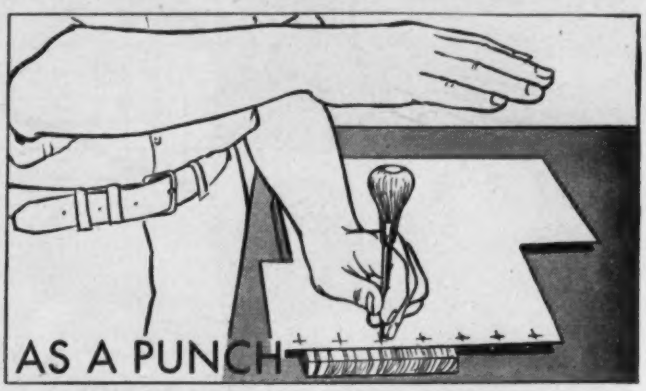
TOOL NOTES

"How To Do It" Information For Crescent Tool Users

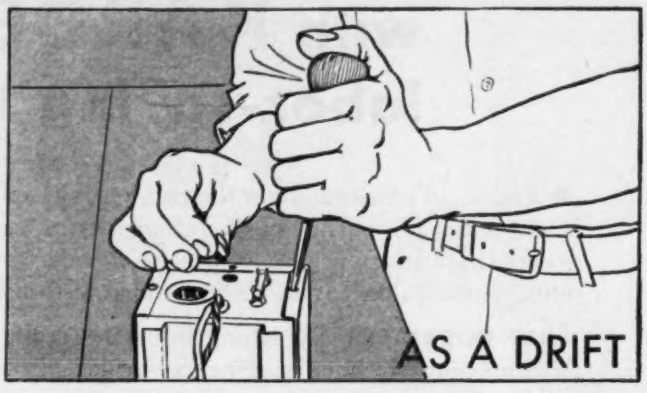
No. 12 . . . HOW TO USE CRESCENT SCRATCH AWLS

For piercing holes in any relatively soft material — wood, leather, linoleum, fabric, fibre, etc. — Crescent Scratch Awls should be used as illustrated below, or the point located and the handle then struck a smart blow with the palm of the hand. Carpenters use this tool extensively for starting screws in soft wood.

For scribing metal and other hard surfaces, the Crescent Scratch Awl is a useful tool. It should be tilted slightly sideways as shown below in order that the extreme point will scribe close to the straight-edge or rule. Maintain this same side angle while scribing and straight, accurate markings will result.



When working with light sheet metal, the Crescent Scratch Awl may be used as a Prick Punch or for piercing holes. Used as a Prick Punch, a hand or light hammer blow is required; for piercing holes, either a blow or steady hand pressure may be used. Use a wood block beneath the metal.



As a drift or driftpin for lining up bolt or rivet holes in light work, the Crescent Scratch Awl is very useful. Its sharp-pointed, tool-steel blade provides a gentle taper from 0 to 1/4 inch, making it an ideal tool for bench and other light assembly work.

MAIL THE COUPON . . . for Free Reprints of this series of informative ads. Please indicate whether you want them for bulletin board use, or punched for 3-ring binder.

CRESCENT TOOL COMPANY, JAMESTOWN, N. Y.

CRESCENT TOOLS
Give Wings to Work

Crescent Tool Co., Jamestown, N. Y. C-4
Please send your "TOOL NOTES" Series
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with KARDEX, the time-saving, labor-saving tool of management

● Today, in offices all over the country, skilled systems engineering is increasing the output of dwindling clerical help. Yes, it has been *proved* that the application of precisely correct office procedures, systems, and equipment can boost office output by as much as 50%!

HOW POSSIBLE? By calling upon the skill and experience of our Systems and Methods Engineers—experts in analyzing and streamlining office records and routines.

THEY MAY SUGGEST, for instance, Kardex Visible Systems that are gearing countless offices to war plant production tempo—providing unparalleled speed of posting and reference, establishing visible control of planning for materials, machines, and manpower. And out in the plant, this tighter planning, more effective follow-through, results in fuller utilization of available forces, keeps production lines rolling steadily, prevents labor-wasting tie-ups. Or, perhaps, Variadex Filing Systems, with wood cabinets, may help assure accurate filing, immediate availability of papers.

WHATEVER YOUR REQUIREMENTS, the Remington Rand engineer can make a thorough analysis of *your* office methods, prescribe the exact systems and equipment for increased efficiency. Call upon him today at our nearest Branch Office.

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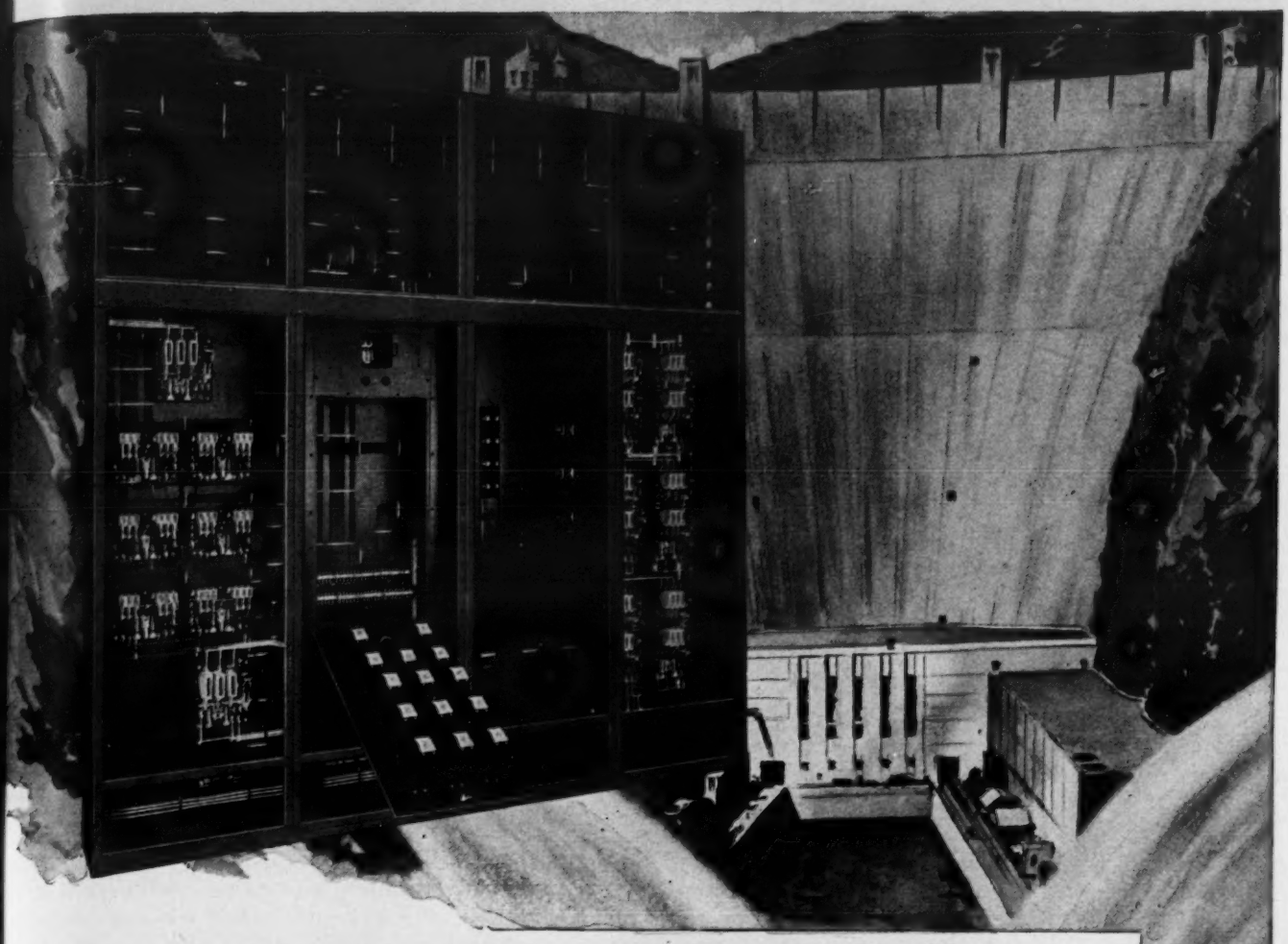
MANPOWER!

SYSTEMS DIVISION
REMINGTON RAND INC.
BUFFALO 3 NEW YORK



WOLFE & MANN
...at BOULDER DAM

ABOVE is the valve and gate control panel, one of 8 electrical installations at Boulder Dam, engineered, designed, and manufactured by Wolfe and Mann of Baltimore. The Wolfe and Mann organization is staffed and equipped to give every contract personal attention and expert engineering skill. Ask the folks at Boulder Dam what they think of the performance and dependability of Wolfe and Mann electrical equipment. Write us about your requirements.

These Projects
ARE OUR REFERENCE

BETHLEHEM STEEL COMPANY
CULPEPER POWER PLANT, CULPEPER, VIRGINIA
NAVY HIGH POWER RADIO STATION, ANNAPOLIS, MD.
UNIVERSITY OF VIRGINIA
WEST VIRGINIA PULP & PAPER CO.
U. S. GOVERNMENT:
BUREAU OF SHIPS
DEPARTMENT OF COMMERCE (LIGHTHOUSE SERVICE)
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WOLFE & MANN
Manufacturing Company

TRADE MARK REGISTERED

SWITCHGEAR ★ SWITCHBOARDS ★ PANELS
28TH AND SISSON STREETS ★ BALTIMORE, MARYLAND

have you added up the facts on

tron power conversion?

1. *No major rotating or moving parts.*
2. *High short-time overload capacity.*
3. *Lightweight, compact, durable.*
4. *High Efficiency over entire load range.*

The above characteristics, found only in the Ignitron Rectifier, add up to tangible advantages for d-c power users.

Ignitron operating costs are low. Simplified automatic operation, low arc drop loss, the elimination of high starting demand and absence of any major moving parts hold operating and maintenance costs to a minimum.

Load shifting is seldom necessary with an Ignitron. It will handle high load swings easily, making it adaptable to widely diversified service conditions.

Installation is easy, too. No special foundations are required. With its lightweight construction and vibrationless operation, an Ignitron can be installed on any level concrete floor of reasonable strength.

Equally important is the uniformly high efficiency of power conversion with the Ignitron, which can operate at full capacity 24 hours per day.

These are a few of the reasons why more than 2,000,000 kw have already been installed. Ignitron may be the solution to your d-c power problems. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MORE THAN 2,000,000 KW serving war industries — in the electrochemical, steel, mining and transportation fields.

in the electrochemical industry

In the electrochemical field, Ignitron Rectifiers have met admirably the extremely severe conditions of continuous operation at full capacity. Applications in this industry continue to increase.

An outstanding advantage of the Ignitron is its relative immunity to corrosive atmosphere encountered in chemical plants.

For more complete information about Ignitron Rectifiers, write today for a copy of Book B-3024. Address Dept. 7-N, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

J-10243-4

Westinghouse *Electronics at Work*

IGNITRON RECTIFIERS

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

By The Sea...

double corrosion-protection

If you intend to install guy wire, static wire or messenger strand in a coastal area where corrosive salt air is apt to attack the wire, consider the use of heavy-coated bethanized strand, "B" or "C" coating, depending on conditions.

This strand is available in three standard bethanized coating weights:

A coating—Meets weight specifications for a standard double-galvanized coating.

B coating—Twice the weight of A.

C coating—Three times the weight of A.

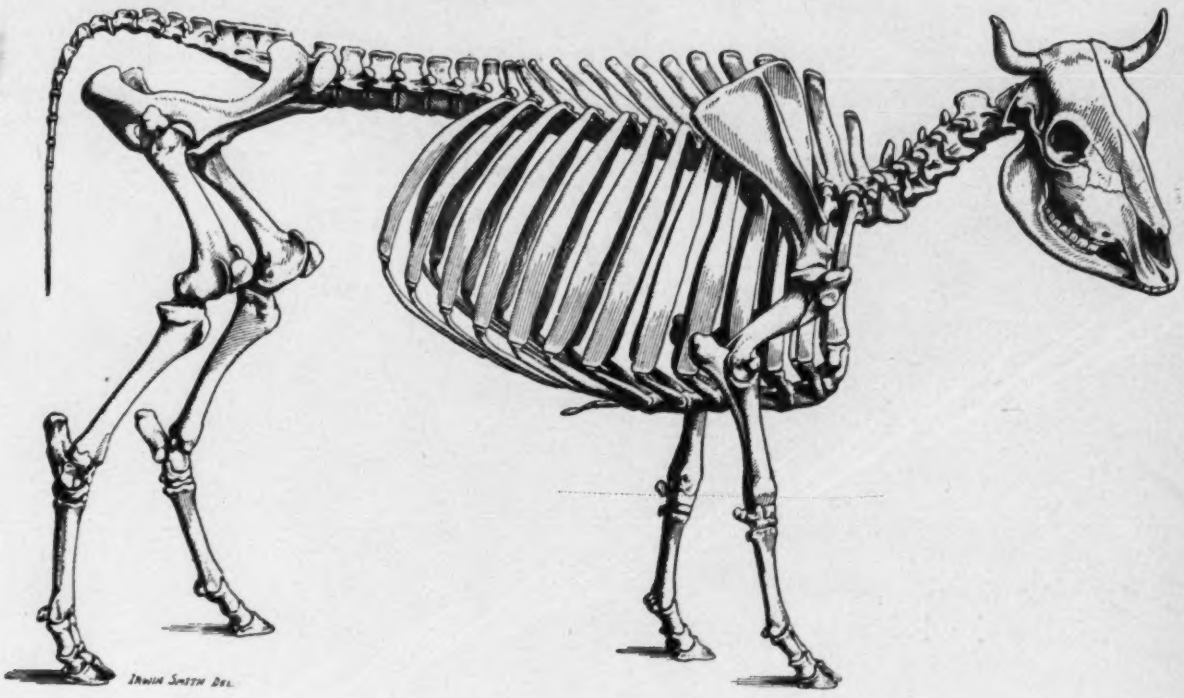
These three coating weights give the line designer a wide choice of corrosion-resistance in strand. No need to go to expensive non-ferrous materials which are generally restricted in use to more critical war needs. He can select a coating weight exactly suited to corrosion conditions in any specific locality. For example, a large power and light company, operating on the Atlantic seacoast, uses bethanized "B" coated strand exclusively for all guys exposed to the corrosive salt air.

The American Society for Testing Materials has conducted tests that clearly indicate that the life of a zinc coating is at least proportional to its thickness. This means you can expect double service from a bethanized "B" coating, triple service from a "C."

The bethanized zinc coating is put on by electricity. It is the purest, tightest, most uniform zinc armor ever applied to wire. No thin spots. No flaking when the strand is spliced or erected. Bethanized strand is available in all strengths—Standard, Siemans Martin, High Strength, Extra High Strength and Specification.

★ ★ ★ BETHLEHEM STEEL ★ ★ ★

THE SKELETON OF A GREAT IDEA



Only 47% of a steer is edible meat. The rest is bones, gristle and other inedible materials.

In the past, meat has been brought to market in carcass form. Countless tons of inedible bones and surplus fat have been transported countless miles...by railroad, ships and trucks. An enormous waste of energy and shipping space!

Today, to save precious shipping space, meat is being shipped to our armed forces abroad de-boned and de-fatted. The skeletons of the steers are being left home.

The U-boats made this change necessary. Modern, high-efficiency refrigeration made it possible.

Steaks and other de-boned cuts of meat are now pressed into compact blocks and refrigerated at low temperatures. Dependable refrigeration equipment has been provided by General Electric for this purpose.

To meet unusual war needs, enormous strides have been made in the development of General Electric *industrial refrigeration* and *air conditioning.*

Equipment is more efficient, more compact, more flexible. When the war ends, these improvements will be applied to peacetime uses and made available to all.

☆ BUY WAR BONDS ☆

General Electric Company, Air Conditioning and Commercial Refrigeration Divisions, Section 438, Bloomfield, New Jersey.

Air Conditioning by

GENERAL ELECTRIC

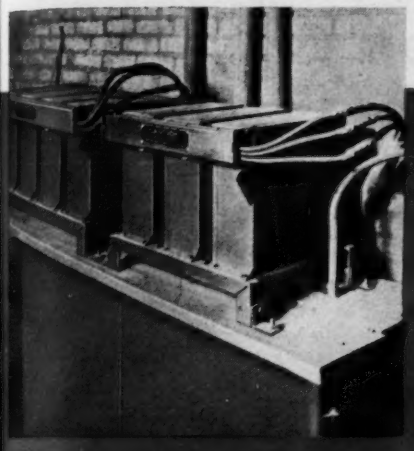
Listen to the General Electric radio programs: "THE HOUR OF CHARM", Sundays, 10 P.M., EWT, on NBC..."THE WORLD TODAY" News, Weekdays, 6:45 P. M., EWT, on CBS

CAPACITORS

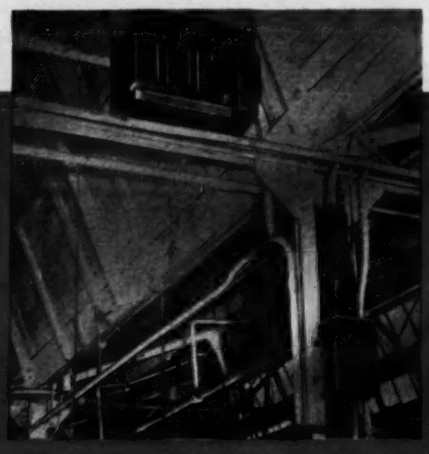
are not cure-alls

but they WILL . . . Raise System Voltage Level . . . Increase Current Capacity . . . Reduce Overheating

Though we are partial to capacitors, naturally, for we make more of them than any other manufacturer in the world, we fully appreciate that capacitors are not the answer to your every electrical problem. But we know that capacitors have their place — and it's a mighty important one. For example, take these reports on typical C-D Capacitor installations for power-factor improvement.



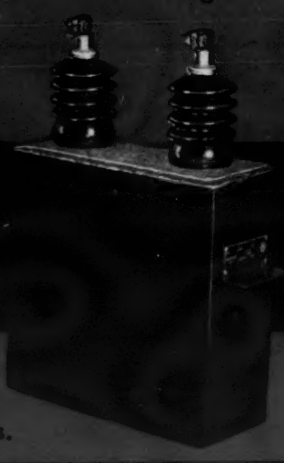
C-D Capacitors Raise the System Voltage Level. At a large industrial plant low power-factor was the cause of considerable voltage drop in the feeders. By installing C-D Capacitors, this company was able to raise the voltage level and secure better voltage regulation—greatly increasing operating efficiency throughout the plant.



C-D Capacitors Increase Current Capacity. A mid-western manufacturer added over 200 motors to keep pace with the wartime demand for his product. By installing C-D Capacitors, the operating current was reduced from 1,840 to 675 amperes — and no additional copper or generating equipment was necessary.

C-D Capacitors Minimize Overheating. The overloaded feeders, motors and switchboards of a machinery manufacturer were running hot and blowing main fuses several times a week. After Cornell-Dubilier Capacitors were installed, overheating was materially reduced and since then, no fuses have been blown.

Many industrial plants and utility systems have solved the problem of wartime power demands by installing C-D Capacitors. Long after the emergency has passed, their Cornell-Dubilier Capacitor installation will continue to work for them 24 hours a day. Our engineers will be glad to survey your system and estimate the advantages of a C-D Capacitor installation as applied to your specific requirements. CORNELL-DUBILIER ELECTRIC CORPORATION, South Plainfield, New Jersey.



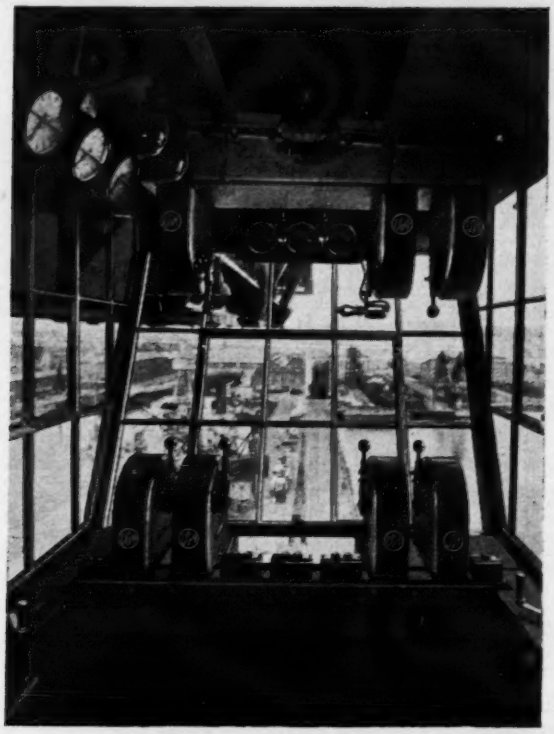
Cornell-Dubilier Capacitors

FOR POWER-FACTOR IMPROVEMENT

CORNELL-DUBILIER CD CAPACITORS

Available on short notice — quickly and easily installed — can be arranged to permit easy switching of corrective capacity to meet changing load requirements.

OF EC&M MASTER SWITCH MINIMIZES FATIGUE *aids* PRODUCTION



OPERATORS like the *exceptionally smooth* operation of this EC&M Master Switch (Type NT). It lessens fatigue—an even greater consideration today than ever before, with more and more women entering industry.

Furthermore, this switch, in combination with magnetic contactor control, produces a *quick response* in motor-driven machines. It gives *more accurate control* of machines and helps a lot in those inching operations.

An important feature, too, is its narrow width allowing several of these EC&M Master Switches to be lined up side by side—*and all easy to reach!*

Bulletin 1182-1 completely describes this Master Switch for use with EC&M Bulletin 921 Crane Control or Bulletin 925 Mill Auxiliary Control. Write for your copies to-day.

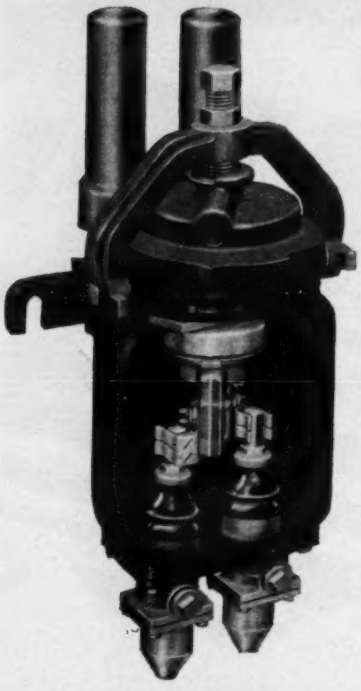
THE ELECTRIC CONTROLLER & MFG. CO.
CLEVELAND ★ OHIO

DO MORE with less!

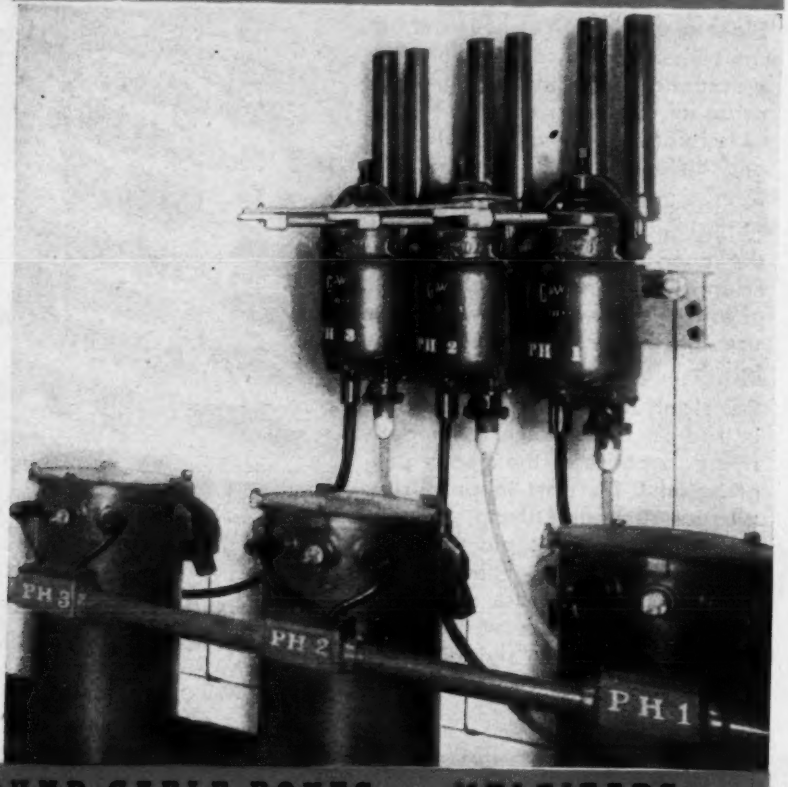
THE G & W WAY

Here are two similar installations, one old, one new. There is no comparison in looks and there is no comparison in performance. G & W Oil Fuse Cutouts make it possible for you to do the job in far less space and with far less labor. They have the extra advantage for today of offering substantial savings of material. They reduce maintenance and they increase safety. But more important still, they give you a simple, fool-proof job that meets today's problems completely. They help you deliver the kind of service that is in demand today.

Look how much better it can be done today — with a set of 3 gang-operated G & W Oil fuse cutouts for fuse-switch protection of the transformer bank. The cutouts are #FC 42SP - 5000 volt, 200 ampere with three phase 60 cycle interrupting capacity of 50,000 Kva.



Let us send our new Bulletin #425 on this outstanding G & W Oil Fuse Cutout. Your request will bring it by mail.



POTHEADS . . . UNDERGROUND CABLE BOXES . . . MULTITAPS
OIL FUSE CUTOUTS . . . SUBWAY OIL DISCONNECTS & SWITCHES

G & W ELECTRIC SPECIALTY CO. 7780 DANTE AVENUE CHICAGO, ILLINOIS

Also made in Canada by POWERLITE DEVICES, LTD., Toronto

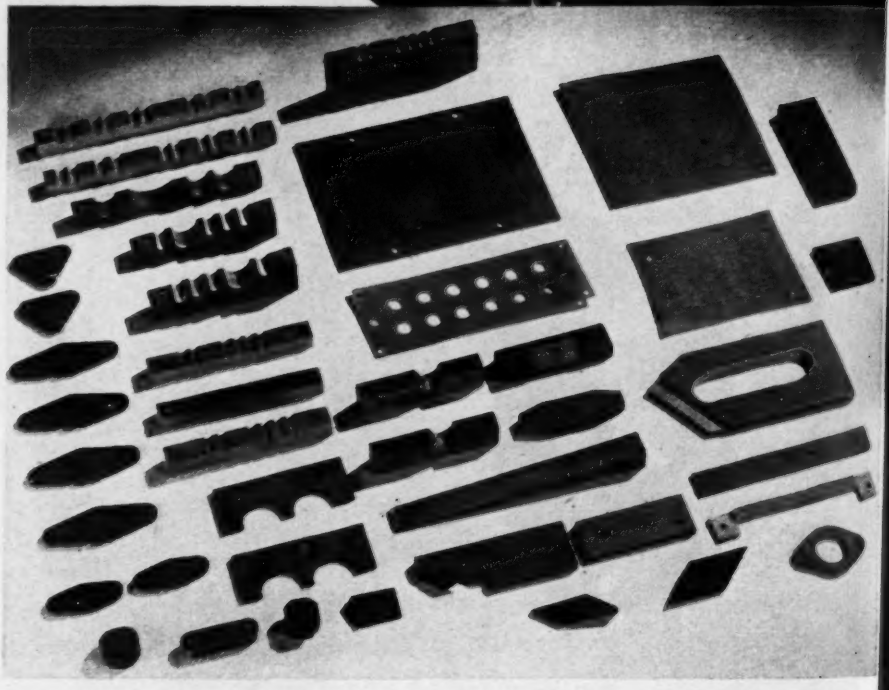
RADIO OPERATOR PHOTOS COURTESY PAN AMERICAN AIRWAYS

LENGTHENING SHADOWS OF PROGRESS

Today, radio communications in civil and military aviation is an important and necessary adjunct that makes possible successful flight operations. Yet, it is only a short time ago since radio played a secondary role in aviation, because of its being subject to the vicissitudes of weather, altitude and distance.

Radio's importance and dependability might well be considered the ever-lengthening shadow of scientific progress . . . the result of improvement, research and the use of better functioning materials.

C-D rightfully claims a large part in radio's importance to modern flying, because of the steady progress on C-D's part in producing plastics such as Dilecto, Celoron and Dilectene . . . plastics from which hundreds of insulating parts, as pictured, are made . . . These C-D Plastics have been engineered to meet "flying" radio conditions.



C-D products include THE PLASTICS . . . DILECTO—a laminated phenolic; CELORON—a molded phenolic; DILECTENE—a pure resin plastic especially suited to U-H-F insulation . . . THE NON-METALLICS, DIAMOND Vulcanized Fibre; VULCOID—resin impregnated vulcanized fibre; and MICABOND—built-up mica insulation. Folder GF describes all these products and gives standard sizes and specifications.

DISTRICT OFFICES: New York - Cleveland - Chicago - Spartanburg, S. C.
West Coast Rep., Marwood, Ltd., San Francisco - Sales Offices in principal cities

Continental-Diamond FIBRE COMPANY

Established 1895 . . Manufacturers of Laminated Plastics since 1911 — NEWARK • DELAWARE

no pits...

no burns...no errors!

Harmful overloads are doomed to defeat when electrical circuits are protected with Westinghouse "De-ion" Circuit Breakers.

Momentary overloads are passed without interruption; but before any disturbance can become dangerous, the sensitive Bi-metal element goes to work, *quick!* The circuit's broken, the arc quenched, in the blink of an eye.

Contact points are protected against severe pits and burns. The "De-ion" arc quencher draws the arc into the chamber, divides and smothers it in half a cycle. Contacts last longer; require less maintenance. And service is just as easily restored.

Once the condition causing the disturbance has been corrected, a simple flip of the indicating handle restores the circuit . . . in seconds. No waiting for a maintenance man; no parts to repair or replace.

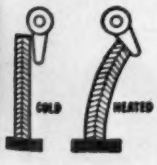
Protect equipment and circuits with Westinghouse "De-ion" Circuit Breakers. Ratings up to 600 amperes; enclosures for practically every type of service. Get in touch with your local Westinghouse representative today. Westinghouse Elec. & Mfg. Co., E. Pgh., Pa., Dept. 7-N.

J-21276

Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

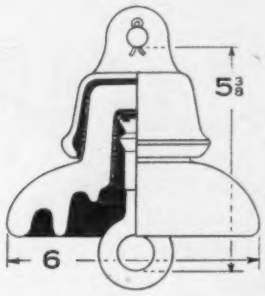
"DE-ION" CIRCUIT BREAKERS



"IN THERE PITCHING" is this Westinghouse Bi-metal element. Two metals which react differently under heat are bonded together. Threatening overloads cause this Bi-metal to bend, tripping the interrupting mechanism, opening the circuit.

CATCHING THE "HOT ONES" is the job of this "De-ion" arc quencher. Made of parallel metal plates in the form of a grid, it draws the arc into the chamber, divides it into segments and smothers it between the plates... all in the space of half a cycle.

To conserve vital materials



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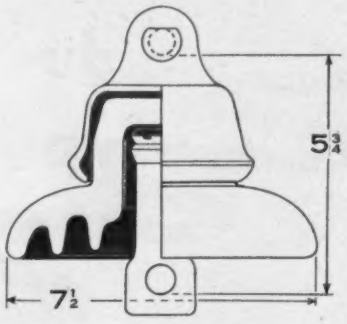

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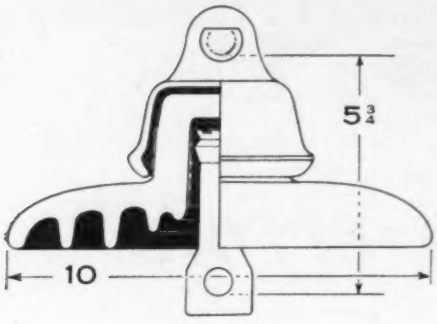
For Dead Ending Distribution Lines

16583	6" dia.	10,000 lb.	M&E
5875	7½" dia.	15,000 lb.	M&E

OBSERVING OUR 50th YEAR OF SERVICE TO THE ELECTRICAL INDUSTRY

For All Standard Transmission Line Construction . .

15,000 Lb. M & E



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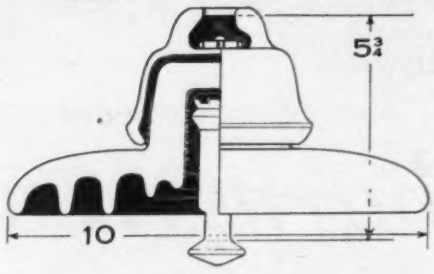
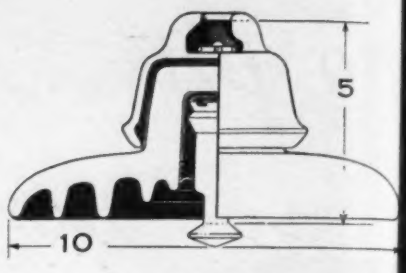


No. 1840



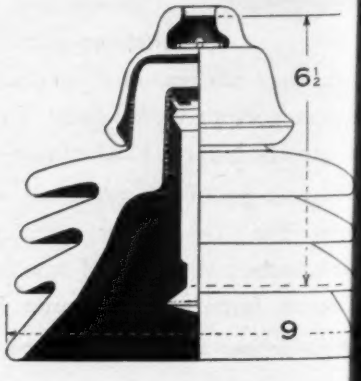
No. 1845

OBSERVING OUR 50th YEAR OF SERVICE TO THE ELECTRICAL INDUSTRY

Similar limitations have been applied to Switch & Bus Insulators. Full information on this will gladly be given you by any Locke representative or direct by mail from Locke Insulator Corporation, Baltimore-3, Maryland.

For Abnormal Dirt or Fog Conditions

15,000 Lb. M & E



No. 18029

LOCKE INSULATORS

OBSERVING OUR 50th YEAR OF SERVICE TO THE ELECTRICAL INDUSTRY

and manpower . . . .

WPB has limited the production of Suspension Insulators to the types shown here.

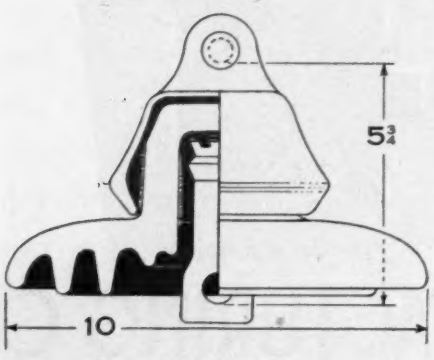
Millions of these Locke Suspension Insulators have been in active satisfactory service for decades.

If the Suspension Insulator you are now using is not shown here, order for future requirements the listed insulator which has the same strength, diameter and spacing as your previous standard. Such insulators are 100% interchangeable.

Now more than ever you will want the extra life and freedom from trouble which service records show to be such an outstanding characteristic of all Locke Suspension Insulators.

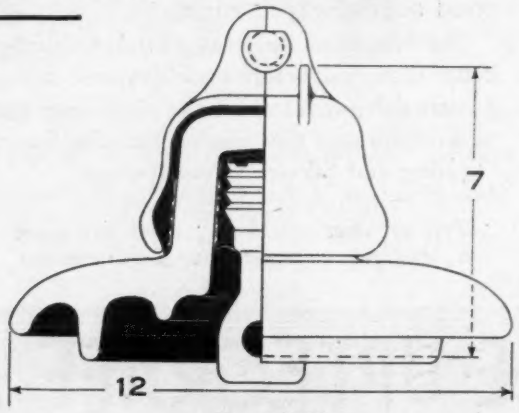
OBSERVING OUR 50th YEAR OF SERVICE TO THE ELECTRICAL INDUSTRY

For **High Strength Dead Ends and Crossings . . .**



No. 7500

25,000 Lb. M & E



No. 15000

35,000 Lb. M & E

CORPORATION BALTIMORE MARYLAND

OBSERVING OUR 50th YEAR OF SERVICE TO THE ELECTRICAL INDUSTRY

UPTEGRAFF

distribution TRANSFORMERS

Uptegraff

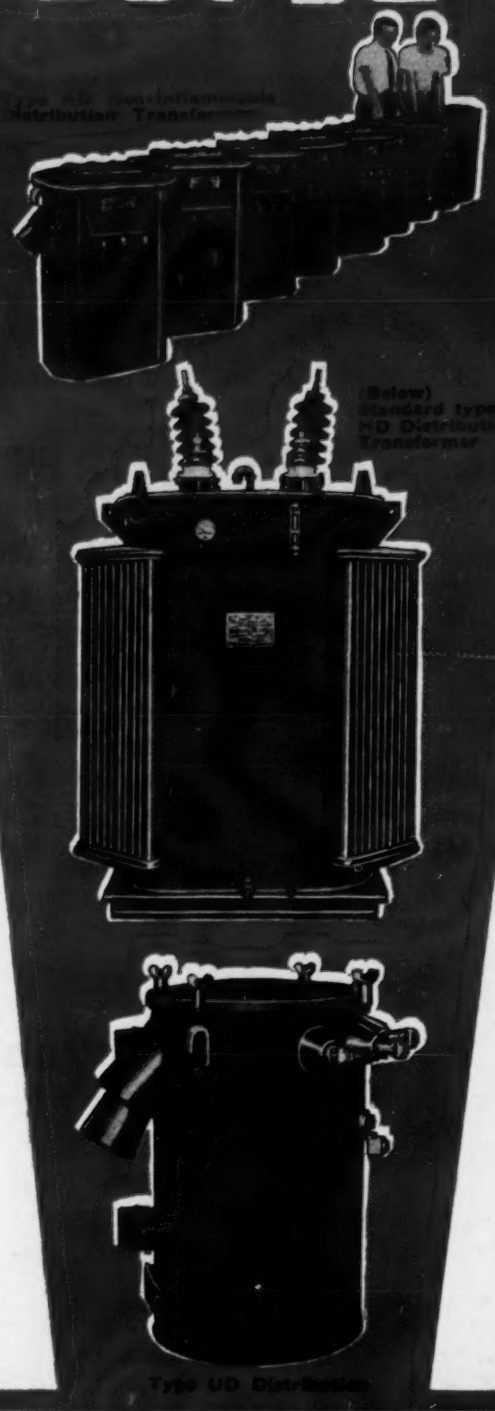
The Time, the Type *and* the Capacity

Over the engineering boards and into production on schedule, your Uptegraff Transformers are shipped to you "as promised" with remarkable certainty.

Into the design go all the "important little things" that are the distinguishing marks of "Quality and Service" in Uptegraff Transformers—the promise that in the time to come on the job you will get years of service stretching far beyond normal expectancy.

Our forces and our plant are today equipped better than ever before to deliver, and deliver on schedule, any and all the types and sizes of Transformers that characterize this line of "Quality and Service" Transformers.

Tell us what you want, when you want it, and see us meet your requirements.



R·E·UPTEGRAFF MANUFACTURING CO·
SCOTTDALE PENNSYLVANIA U·S·A·

An Entire System Depends on a Forging

At present the forging industry is all-out for war. However, BTC Forged Hi-Line Hardware has been ruled too vital to suspend – even temporarily. A perfect example is shown in the Forged Steel pins illustrated above.

Your heaviest hook-up is only as strong as the pins that connect the insulators. These small pins are always steel. Ask any insulator manufacturer.

Through Your Insulator Manufacturer Only

BTC

Transmission Line Hardware

THE BREWER-TITCHENER CORPORATION – CORTLAND, NEW YORK

ONE ANSWER

TO 3 QUESTIONS ABOUT TRANSFORMERS

1. How can heavier loads be handled?
2. How can this equipment be protected against loss?
3. How can service interruptions be reduced?

LOADING BY COPPER TEMPERATURE (L.C.T.) WITH CSP TRANSFORMERS

The answer to these questions is based on this fact: Loading by Copper Temperature (L.C.T.) increases usable transformer kv-a by 25% to 40% —with complete safety!

1 **L.C.T.** puts the reserve thermal capacity of a transformer to work. Emergency overloads can be carried longer, without danger, right up to the thermal limit of the windings.

2 **L.C.T.** gives sure protection against burnouts—positively disconnects a dangerous overload before windings can be damaged.

3 **L.C.T.** provides a visible indication of dangerous overload conditions so that load can be arranged, if necessary, to avoid power "blackouts."

Ask your Westinghouse engineer to give you the facts about this transformer development. He'll be glad to submit definite recommendations . . . glad to help you get more out of your transformer applications. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N. J-70398

TRIPLE ACTION

FOR PROTECTING TRANSFORMERS

MEASURES the amount of overloa Loading by Copper Temperature uses *actu* winding temperature, takes into considerati load duration and magnitude.

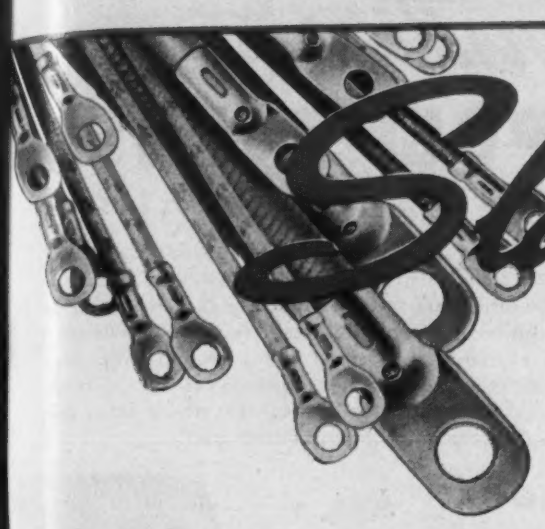
SIGNALS approach of thermal capacit Unnecessary interruptions of service a avoided because a red warning light flash when dangerous winding temperature is bei approached.

DISCONNECTS load from transform If overload actually becomes dangerous, internal circuit breaker *automatically* moves the load from the transformer.

Westinghouse

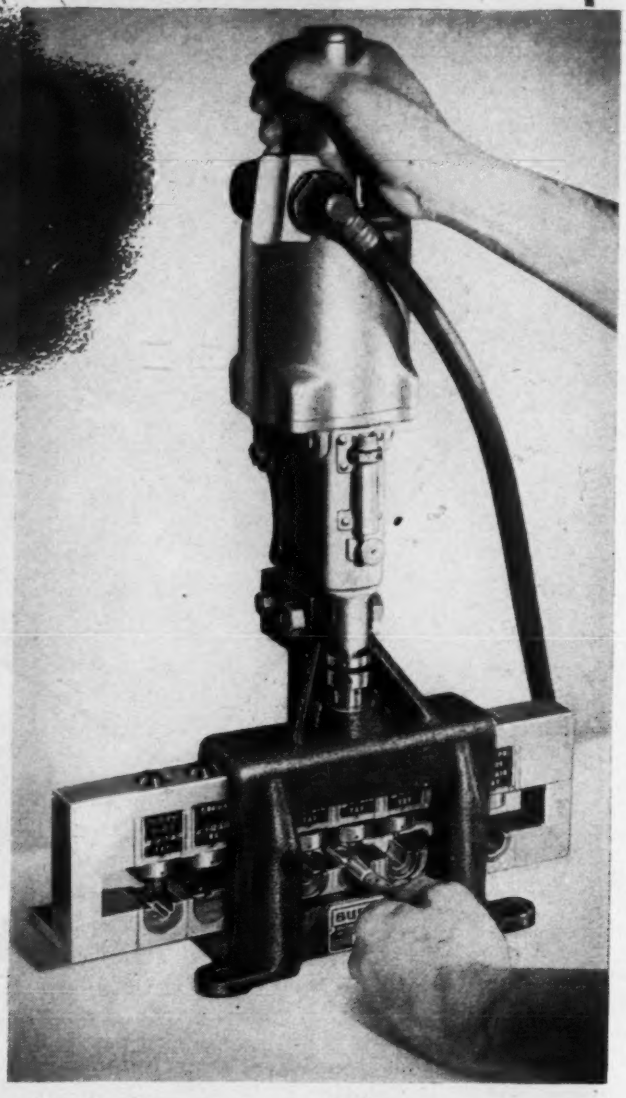
PLANTS IN 25 CITIES ... OFFICES EVERYWHERE

CSP TRANSFORMERS



Slashes time indenting HYLINE connectors

BURNDY multi-range HYPRESS (type Y-NSC)



re's a streamlined pneumatic bench press which *slashes* time aching BURNDY small wire terminals and connectors . . . even h inexperienced operators.

For this HYPRESS has a *multi-range* die rack which accommodates different indenting die-sets, in any combination of wire sizes m #29 to 4/0. Each die position is clearly marked for wire e and connector type. Thus no time is ever lost "setting-up" different sizes or types of connectors. You merely slide the ck to the correct size . . . and start indenting.

And connections are made *as fast as you can feed, and press* trigger. Made *securely*, too; for the holding die positions the g *exactly*, and the fixed travel of the ram assures uniform in- nt every time.

Burndy bench type as well as portable HYPRESSES, and Burndy YLINE Connectors, are being used by leading manufacturers roughout the U. S. and Canada. Complete information on these oducts, as well as engineering cooperation on any connector oblem, is freely offered.

URNDY ENGINEERING CO., INC.
07 EASTERN BOULEVARD, NEW YORK CITY

ndy **HYLUG** — compact, one- ce terminals forged from pure pper.

Burndy HYLUG YBV — one of many for special applications.

Burndy HYLINK — end-to-end connectors — one-piece construction.

Burndy LINKIT—the detachable connector, with no loose parts.

Dunco Sensitive

RELAYS FOR LOW-POWER USES

TWICE TESTED . . . BALANCED TO STAND VIBRATION

For vacuum tube circuits—for the protection of delicate instrument contacts—for alarm circuits—for exacting temperature control—wherever the need is for dependable relays to operate on very low coil circuit power, you will find Dunco Sensitive Relays unexcelled.

Each unit is specifically "tailored" to its specific job. Each has its moving parts carefully balanced, making it suitable for use where vibration is encountered. Each is twice-tested before leaving the factory.

Shown here are sensitive relays of the Dunco Series 28 (high-sensitivity), and Series 29 (medium-sensitivity) types available in various styles of mounting. Numerous sensitive Dunco Midget Types are likewise available for similar low-power uses where small size and light weight are important factors.

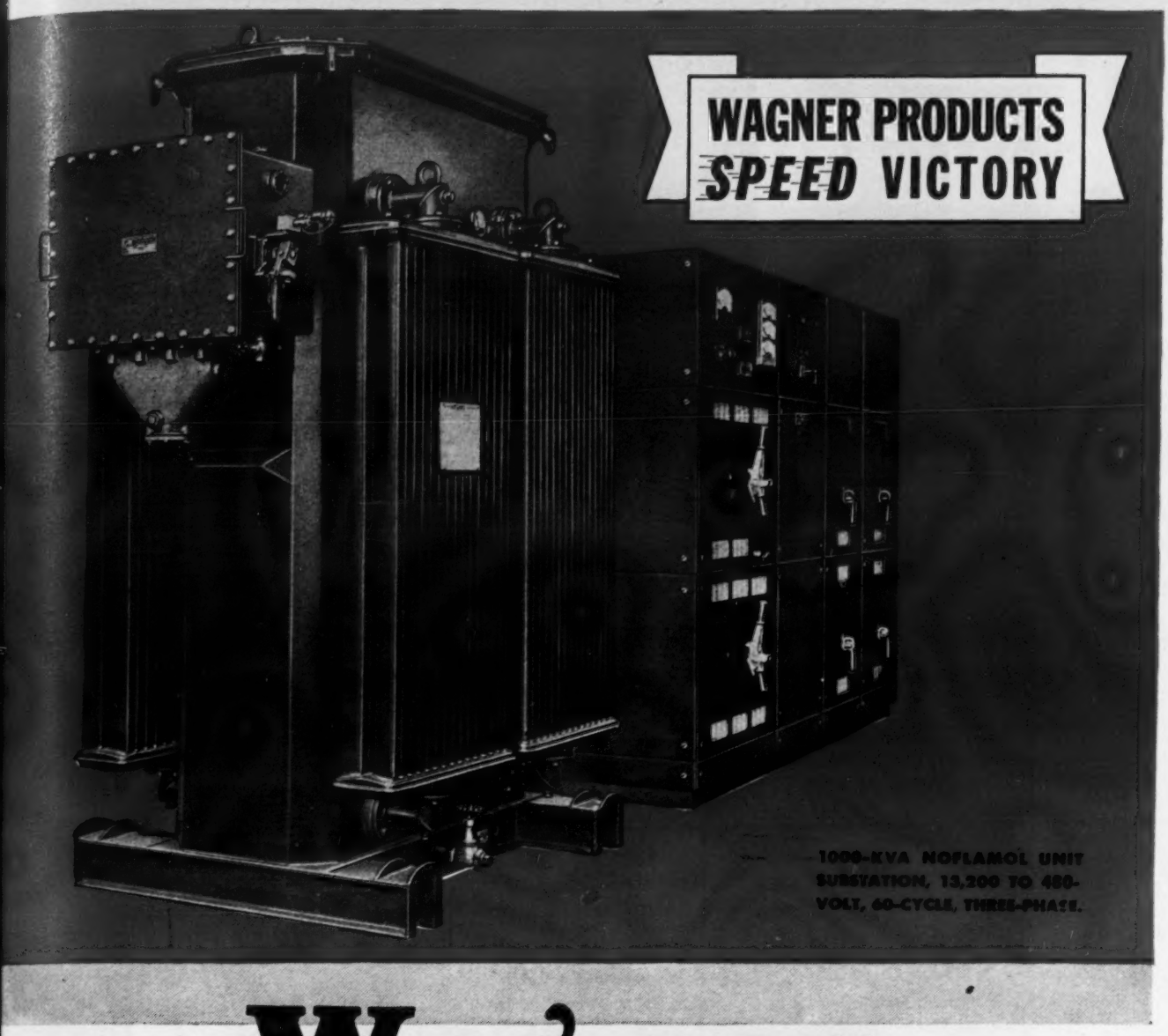
DUNCO CATALOG AND RELAY DATA BOOK

You can find the right relay for almost any application in the 48-page Dunco Catalog—also helpful engineering information and suggestions on relay selection and use. Copy upon request.

STRUTHERS DUNN, Inc.

1321 ARCH STREET **PHILADELPHIA, PA.**

LET DUNCO DISTRICT ENGINEERS IN 28 STRATEGICALLY LOCATED CENTERS HELP SOLVE YOUR RELAY PROBLEM



WAGNER PRODUCTS *SPEED* VICTORY

1000-KVA NOFLAMOL UNIT SUBSTATION, 13,200 TO 480-VOLT, 60-CYCLE, THREE-PHASE.

Wagner
UNIT SUBSTATIONS

are doing their part in the production of steel, synthetic rubber, oil, and other vital materials

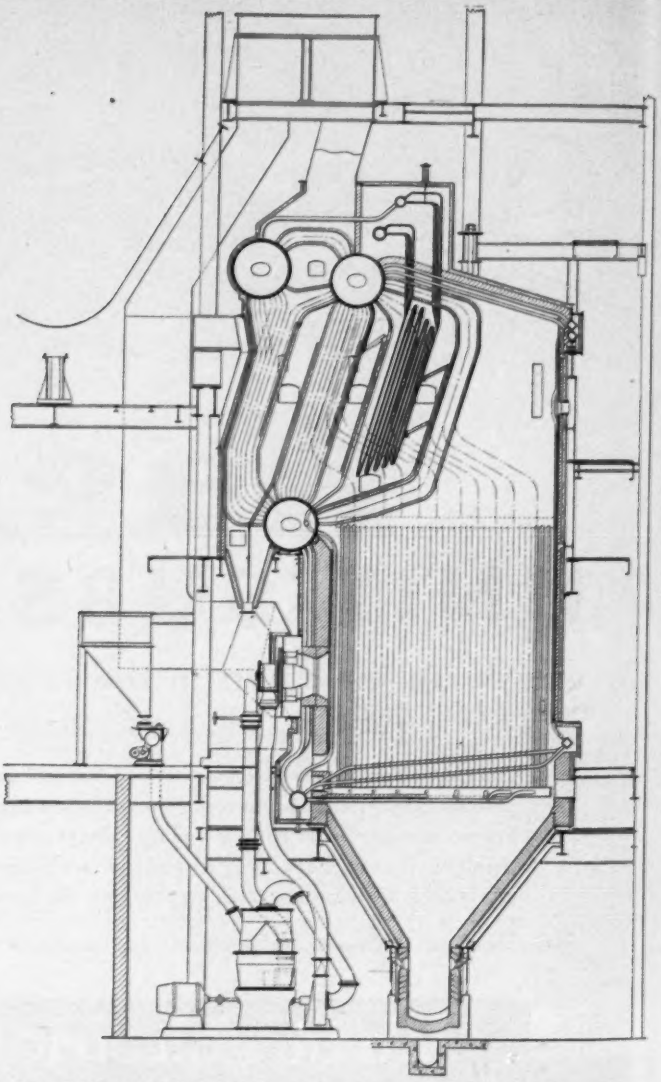
The Unit illustrated above is installed in a synthetic rubber plant. The transformer has a two-position liquid-filled disconnecting switch on the high-voltage side which is equipped with low-voltage interlock. The low-voltage side is equipped with air-break circuit-breakers electrically or manually operated, ground indication lights, voltmeters, ammeters, and ammeter test blocks. Unit has one main breaker, one tie transfer breaker, and four feeder breakers.

For Complete Information on Wagner Unit Substations write or phone the nearest Wagner branch office.

Wagner Electric Corporation
ESTABLISHED 1891
6456 Plymouth Avenue, St. Louis, 14, Mo., U. S. A.
ELECTRICAL AND AUTOMOTIVE PRODUCTS

T43-5

1 year of wartim



One of the two C-E Steam Generating Units responsible for the performance cited on the opposite page. Maximum continuous capacity—130,000 lb of steam per hr. Design pressure—725 psi. Total steam temperature—825°F.

ervice...

1% outage

CHARGED TO THE BOILERS

Longer than your arm is the staggering list of varied war products that emanate daily from hundreds of plants throughout industrial Connecticut. And a basic factor in the continuity of their performance has been adequate electric power made available by the public utilities of the state.

One example is a power station where all the steam for a single 25,000 kilowatt turbine generator is supplied by two C-E steam generating units, one of which is shown on the left-hand page.

The great effectiveness of this power station in providing kilowatts for victory is proved by its operating record for a full year of wartime service in which the use factor established for the entire station was 87%. The quality of the performance of the steam generating equipment during this period is indicated by a combined availability for the two boiler units of 99% . . . only 1% outage was charged against the boilers.

Here is another instance of how the public utilities of America were ready for war because their peacetime policy was devoted to providing an abundant and dependable supply of electric power. A-746

COMBUSTION ENGINEERING

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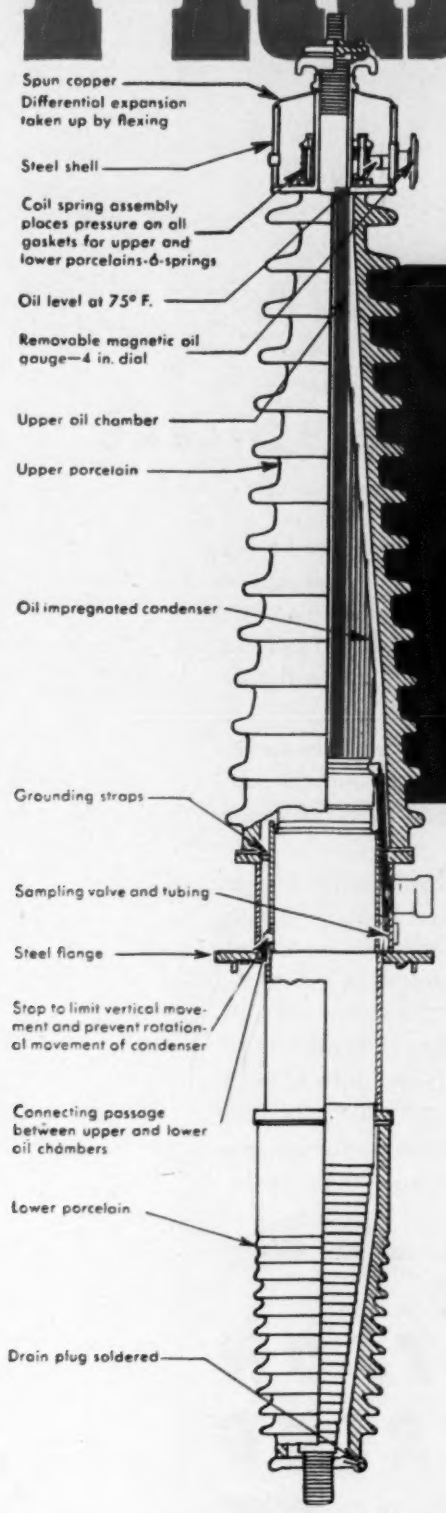
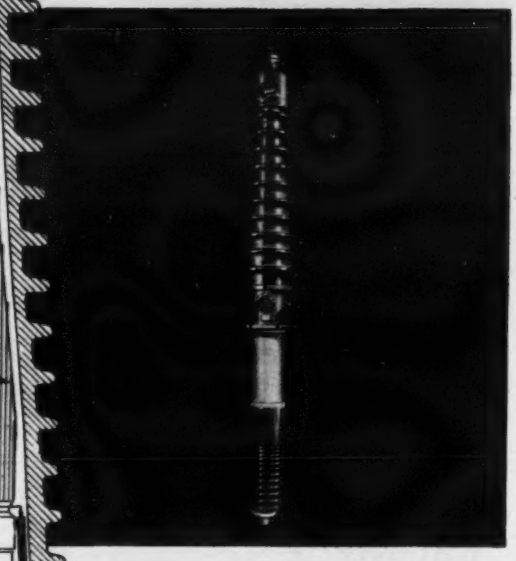
Canadian Associates

Combustion Engineering Corporation, Limited
Montreal • Toronto • Winnipeg • Vancouver

PROTECTED

From the inside out


Spun copper
Differential expansion taken up by flexing
Steel shell
Coil spring assembly places pressure on all gaskets for upper and lower porcelains-6-springs
Oil level at 75° F.
Removable magnetic oil gauge—4 in. dial
Upper oil chamber
Upper porcelain
Oil impregnated condenser
Grounding straps
Sampling valve and tubing
Steel flange
Stop to limit vertical movement and prevent rotational movement of condenser
Connecting passage between upper and lower oil chambers
Lower porcelain
Drain plug soldered



THE WESTINGHOUSE OIL-IMPREGNATED CONDENSER BUSHING

You have to look *inside* the Type "O" Condenser Bushing to find the real insulation—*the condenser*. The outside porcelain serves primarily as a weather casing; the oil filling as a secondary sealing agent. But the real job of isolating high voltage from ground is done by the *exclusive* Condenser Insulation.

Just like the leaf springs in your car, this design distributes stresses uniformly. This means long life for the dielectric material, uniform electrical performance, negligible radio interference and minimum size.

As a permanent seal against moisture, all joints of the Type "O" Bushing above oil level are soldered or brazed, while gaskets are used below the oil level. The oil-filled space between the condenser and the porcelain acts as a reservoir insuring that the condenser will always be surrounded with oil and completely impregnated. A magnetic oil gage continuously indicates the level of the oil.

Your Westinghouse representative has further details on the Type "O" Condenser Bushing. Consult him, or write: Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N.

J-60537

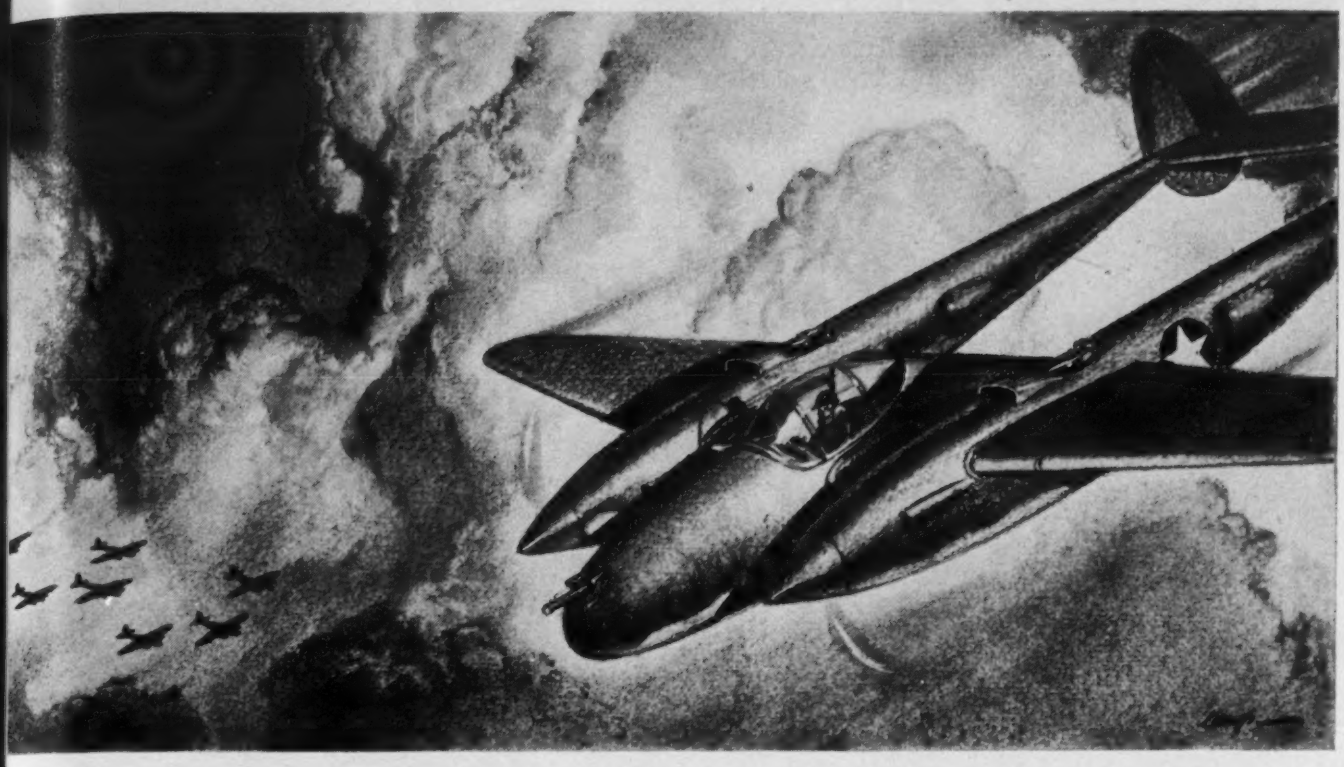
Westinghouse supplies Type "O" Oil-impregnated Condenser Bushings for service voltages from 92 to 230 kv. Type "O" Bushings of the same voltage and current ratings are interchangeable between oil circuit breakers and large power transformers.

Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

CONDENSER BUSHINGS

PERMANENT MAGNETS MAY DO IT BETTER



"RADAR WAS RIGHT—HERE THEY COME!"

THIS American fighter pilot, with his squadron, is "parked" in the clouds waiting to knock down a flight of Axis bombers. What warned him that they were approaching? How did he know their exact location, speed and direction? The answer—*Radar*—the "electronic eye". We are proud, indeed, to have a part in its efficient performance.

Our business, in war and peace, is designing and building *better* permanent magnets, and applying them intelligently so that the functions of countless types of products are improved and their uses multiplied. Concentrating on this one job for 33 years has resulted in our becoming an outstanding organization in this field—with an efficient and completely equipped plant devoted exclusively to this work—and with engineering and production personnel of specific ability.

* * *

Though our capacity is now devoted to the winning of the war, we are extremely interested in the development and improvement of products for war and post-war use. We suggest that you consult with our engineers. They may show you how the performance of your product can be improved with permanent magnets. Write for the address of our office nearest you and a copy of our 30-page "Permanent Magnet Manual."

The
INDIANA STEEL PRODUCTS
Company

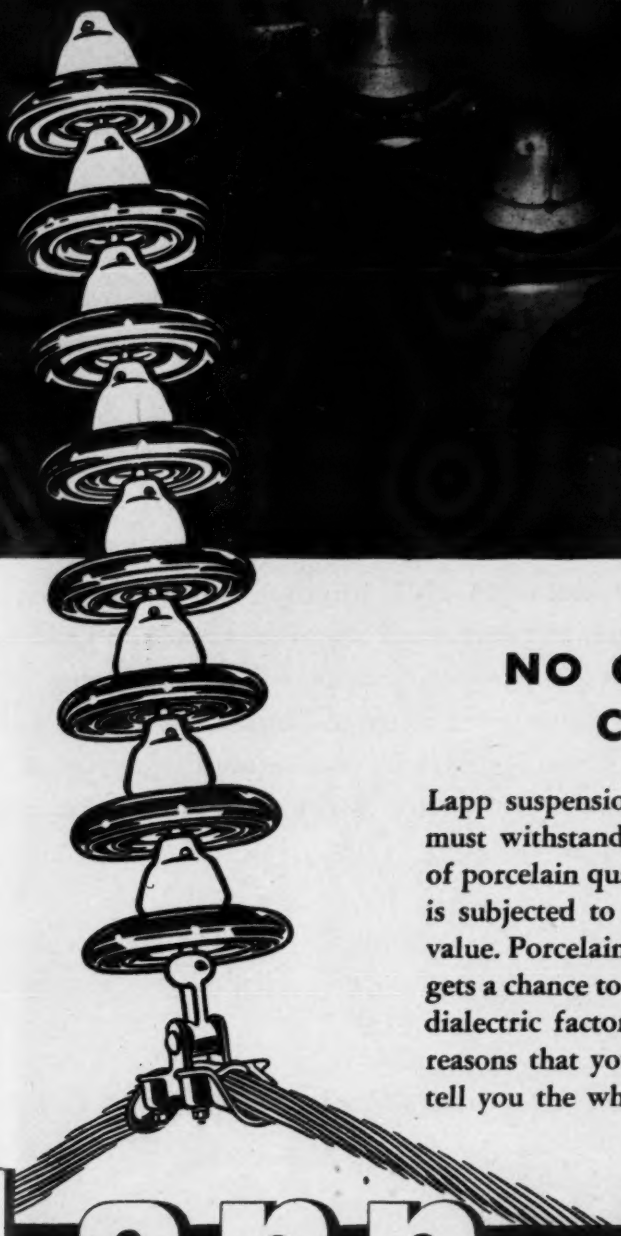
★ SPECIALISTS IN PERMANENT MAGNETS SINCE 1916 ★

6 NORTH MICHIGAN AVENUE • CHICAGO, ILLINOIS

A nice, thick, juicy steak. Gratifying at any time, but especially so these days. . . . Likewise through the years, gratifying to you must have been, the uninterrupted service given by the Chromel-equipped heating devices on your lines. And today, with Chromel so scarce for renewal elements, is it not doubly satisfying to have that heating load still plugged in and producing revenue—because their durable Chromel elements keep them in service? (It's also good for us all to know that, meanwhile, Chromel is making things hot for Hitler!) . . . Glad to send you Catalog—M.

Chromel
NICKEL CHROMIUM
HOSKINS
CHROMEL
ELECTRICAL HEATING ELEMENT
WIRE

HOSKINS MANUFACTURING CO. • DETROIT, MICH.

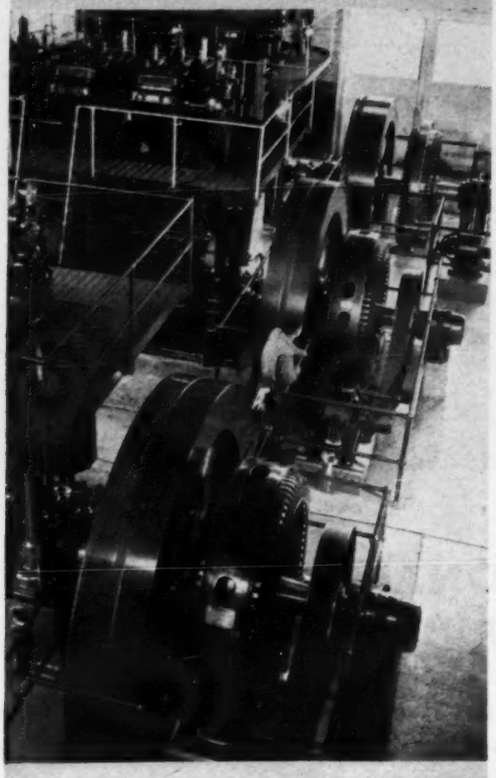


NO QUESTIONABLE PORCELAIN CAN SURVIVE THIS TEST

Lapp suspension insulator units, before being approved for shipment, must withstand the Overpotential Test, the industry's most severe test of porcelain quality. Its rim immersed in oil to prevent flashover, the unit is subjected to 60 cycle current at voltage higher than rated flashover value. Porcelain not up to the Lapp standard, punctures in this test, never gets a chance to fail on your lines. Units that survive are assured a definite dialectric factor of safety. The Overpotential Test is one of the many reasons that you do better with Lapp insulators on your lines. May we tell you the whole story? Lapp Insulator Co., Inc., LeRoy, N. Y.

Lapp

Better Porcelain • Better Insulators



The **why** *of better Diesel Lubrication with Gulf Parvis Oil:*

1. **Higher Lubricating Value — for more effective protection**
2. **Greater stability and endurance — for longer lasting protection**

"Gulf Parvis Oil is the most satisfactory Diesel lubricant we've ever used," says the Chief Engineer of a large municipal power plant. "With this quality oil in service, our overall efficiency is greater and our maintenance costs are lower."

The *higher protection value* of Gulf Parvis Oil stands out today—when power demands can usually be met only by peak-load and over-load operation of Diesel units. For severe service proves the exceptional endurance and stability of this oil. Its tough film stands up and provides full protection under conditions which often cause excessive wear, high maintenance expense, and below-standard Diesel performance.

For maximum efficiency and highest operating economy in *your* plant, call in a Gulf Lubrication Service Engineer now and ask him to recommend the proper grade of Gulf Parvis Oil to fit your particular equipment and operating conditions. His thorough training and broad experience with all types of Diesel engines is your assurance of sound and helpful recommendations. Write or 'phone your nearest Gulf office today.

GULF INDUSTRIAL LUBRICATION

Gulf Oil Corporation · Gulf Refining Company

Gulf Building, Pittsburgh, Pa.

Don't Worry

ABOUT THE BAN ON OVERSIZE MOTORS

Copperspun

You don't need oversize anyway when you use F-M Copperspun Motors

The fact that W.P.B. restrictions prohibit the purchase of extra size in a motor is nothing to worry about. Fact is, this restriction will conserve critical materials and *save you money*—because, with Fairbanks-Morse Motors with *Copperspun* Rotors on the job, you don't need extra size or extra horsepower to protect the motor in tough service. You can run F-M Motors with Copperspun Rotors under full load *indefinitely* without danger of damage, because these motors depend on extra quality rather than extra size for their stamina.

The winding of the *Copperspun* Rotor is *centrifugally* cast, in *one piece,* and of *pure COPPER.* Copper has better thermal characteristics. Copper has better electrical characteristics. No other rotor winding is cast of *COPPER.*

Fairbanks, Morse & Co., 600 S. Michigan Avenue, Chicago. Branches with service stations throughout the U. S. and Canada.

FAIRBANKS-MORSE

DIESEL ENGINES
PUMPS
MOTORS
GENERATORS
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FARM EQUIPMENT
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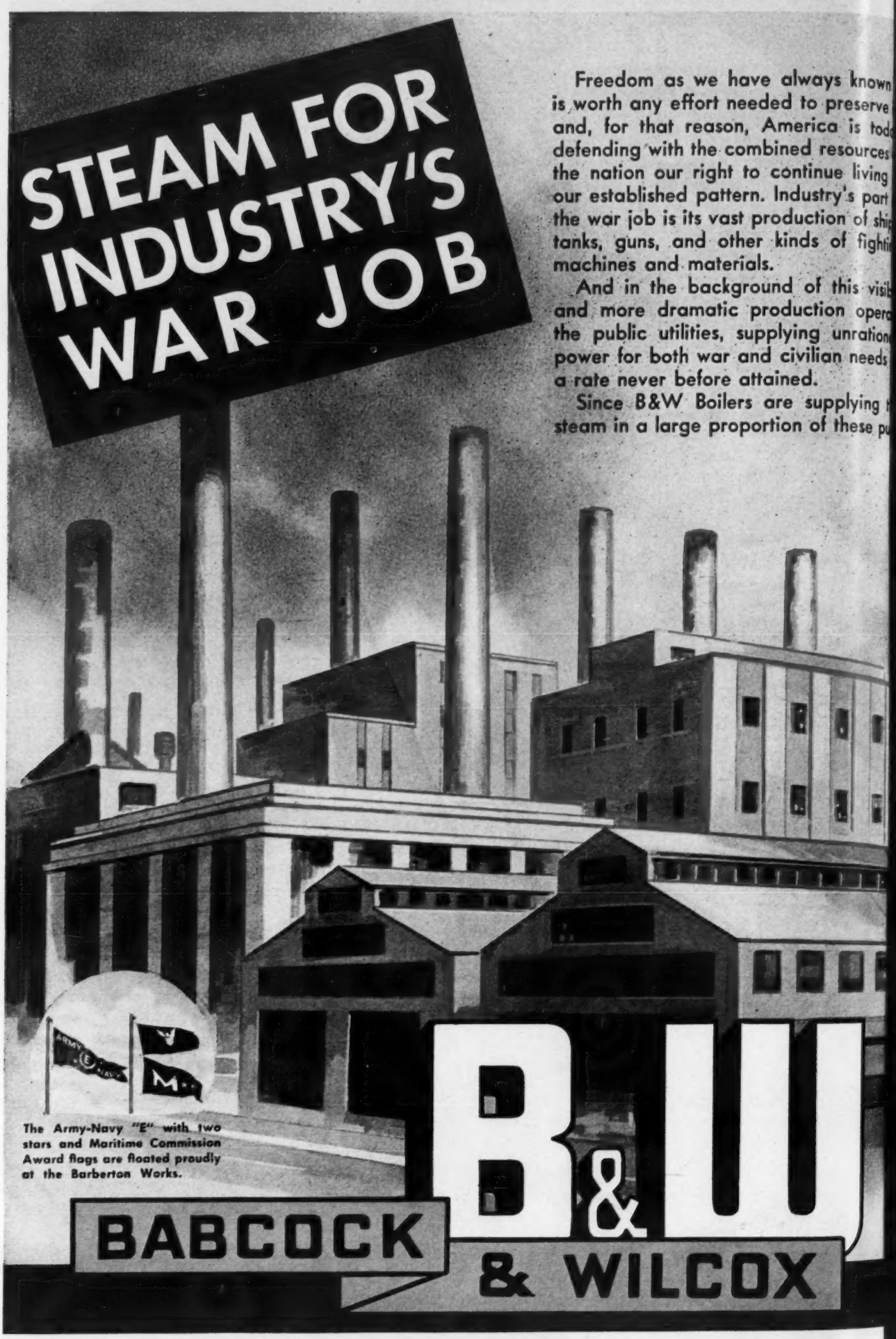
Motors

STEAM FOR INDUSTRY'S WAR JOB

Freedom as we have always known
is worth any effort needed to preserve
and, for that reason, America is tod
defending with the combined resources
the nation our right to continue living
our established pattern. Industry's part
the war job is its vast production of shi
tanks, guns, and other kinds of fighti
machines and materials.

And in the background of this visib
and more dramatic production opera
the public utilities, supplying unration
power for both war and civilian needs
a rate never before attained.

Since B&W Boilers are supplying
steam in a large proportion of these pu

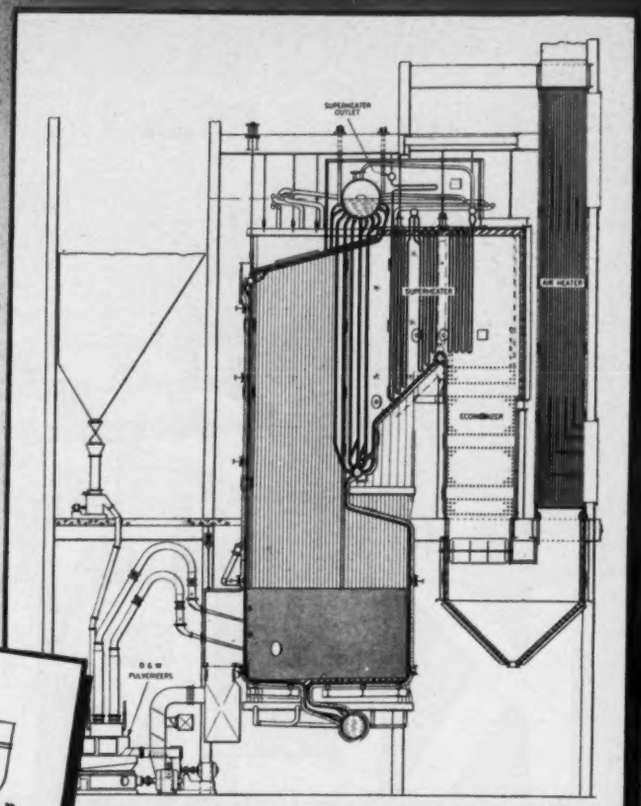


The Army-Navy "E" with two stars and Maritime Commission Award flags are floated proudly at the Barberton Works.

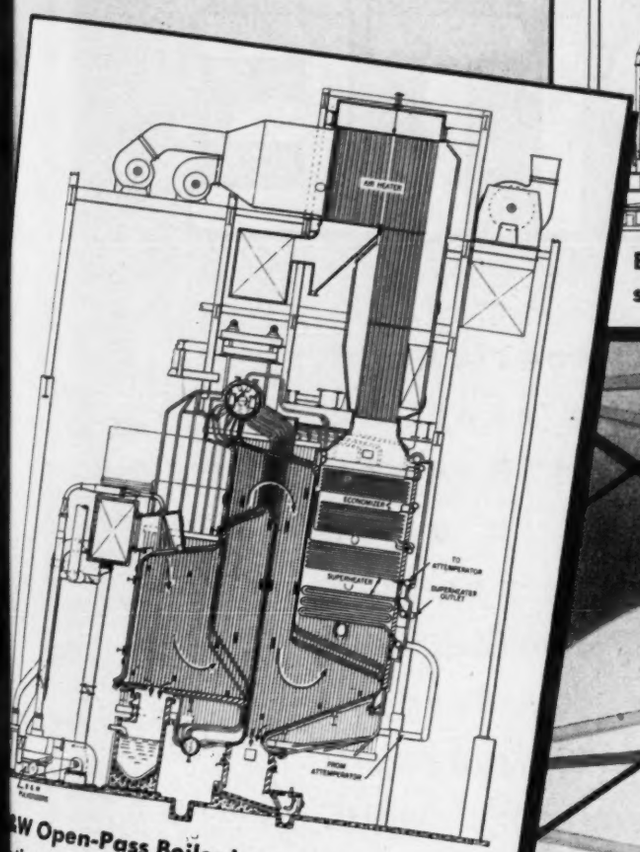
BABCOCK & WILCOX

B&W

utility and industrial power plants, and propelling naval and cargo ships, B&W playing a substantial part in this great r effort. B&W engineering and production skill have built into its boilers the mina to endure today's gruelling drive. With today's accelerated experience lding more complete answers to such oblems as behavior of metals at high mperatures, action of fuels in slag-tap d dry-ash furnaces, circulation in high-pacity high-pressure boilers, separation steam from water in boiler steam drums, d other related problems, the boilers of morrow should be even better able to ve industry.



B&W Radiant Boiler in an eastern central station—Capacity 400,000 lb. steam per hr.



W Open-Pass Boiler in an eastern central tion—Capacity 350,000 lb. steam per hr.

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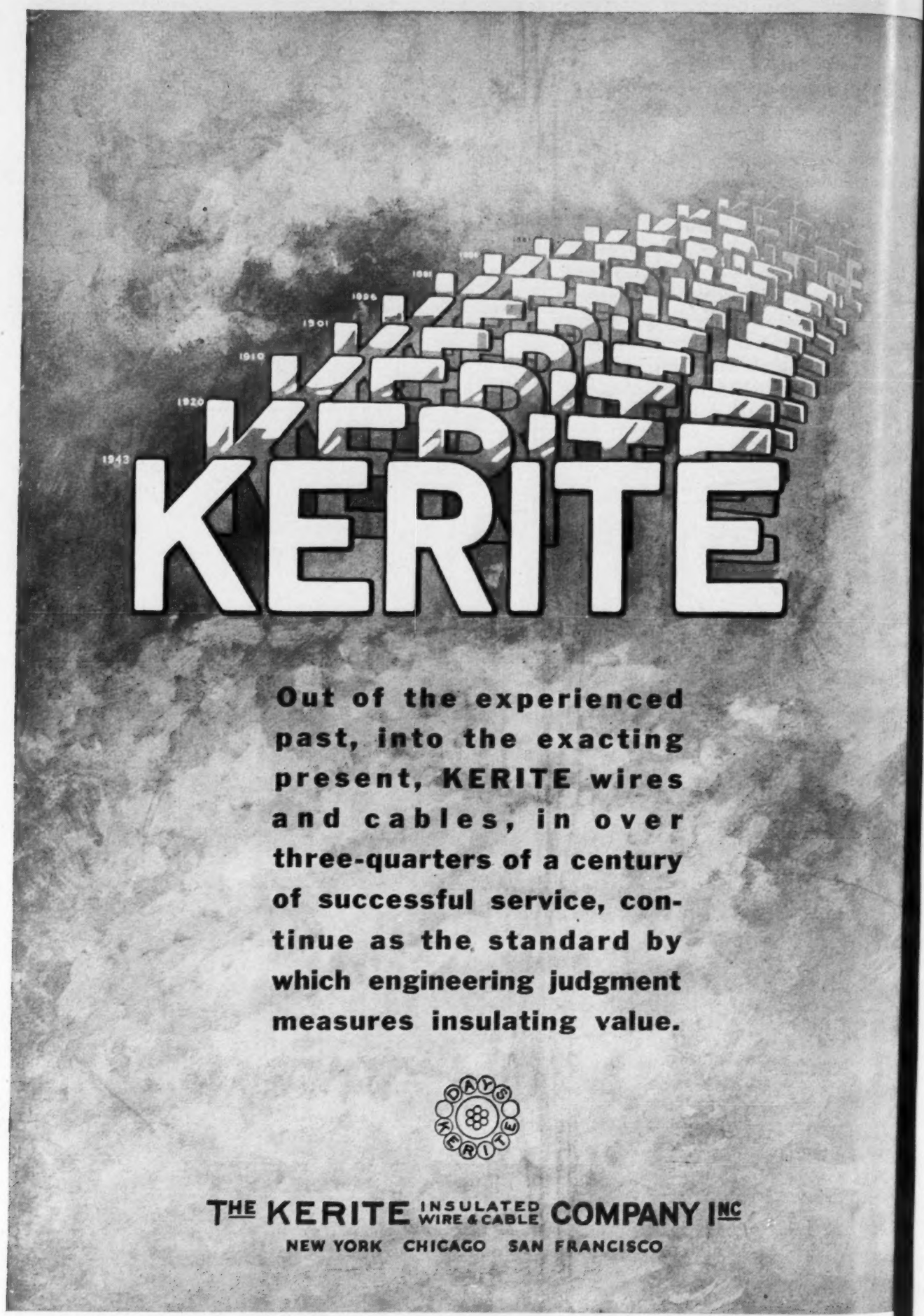

1901
1910
1920
1943
KERITE
Out of the experienced past, into the exacting present, KERITE wires and cables, in over three-quarters of a century of successful service, continue as the standard by which engineering judgment measures insulating value.
DAYS
KERITE
THE KERITE INSULATED WIRE & CABLE COMPANY INC
NEW YORK CHICAGO SAN FRANCISCO

Post-War Trade Relations

Great interest is being expressed today in post-war trade relations. What will be the position of the utility with respect to merchandising, to promotion? What new kinds of distribution plans will be started, if any? What direction will appliance standardization take? Who will be responsible for refresher education? Will post-war revision of the National Electrical Code be orderly, or will it be a shambles? Will national market promotion be co-ordinated?

These intra-industry problems are important, but there is no way at the present time for them to be brought to a head nationally. Not only is there no forum for the discussion of intra-industry matters, but there is no manifest desire on the part of the several associations to thresh out mutual problems of this nature.

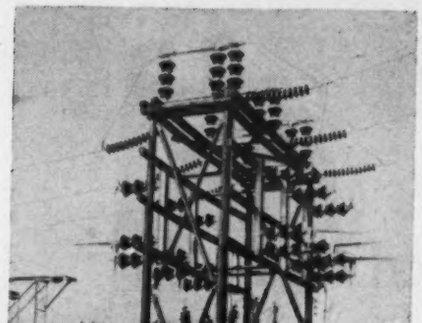
Surely it can't be because the associations do not think these matters of any great import. The post-war success of every branch of this electrical industry will be in proportion to the degree of co-operation that exists. If promotion plans are worked out that will get the support of all interests, will not everybody do more business than if the plans are those of a single branch? If educational plans are not co-ordinated and to a degree standardized, will not the benefits be restricted?

One would think that with all these benefits to be derived from organized co-operation something would have been done about it long ago. Co-operative promotional efforts have been started, and some of them have made considerable progress, but at no time, whether because of internal jealousies or lack of vision, have the electrical industry leaders placed their unqualified approval upon the principle. There is no standard procedure. There is practically no co-ordination with other programs. There is no unification of the whole, and sometimes not of the parts.

The strange thing, however, is that this disunity does not seem to stem from the grass roots, because there are innumerable places where local co-operation is of the best. Something is wrong when national thinking does not reflect local thinking and action.

Whatever it is, it can be corrected if men will put their minds to it. It is going to require give and take, regardless of who is putting up how much money. It is going to require respect for the other fellow's point of view. It is going to require men of integrity and purpose—men respected and trusted not only by their own branches of the industry but by all other branches—men who can work with other men.

The stakes in this post-war game are too large to permit any discordant elements, be they men or be they associations, to stand in the way. Each day the time to prepare is shortened. Since this is a problem that cannot be threshed out in a week or two, but will require a lot of discussion, shouldn't the preliminaries start right now?



BRACED WOOD FRAMEWORK for fenced 110-kv. oil circuit breaker installation at point where Arkansas-Missouri Power Company's line is tapped for service to pumping stations 7 and 8

Power Lines to Serve "Big Inch" Pipe Line

Fifteen utilities serve the 130,000-hp., ¾-billion kilowatt-hour load over 200 miles of transmission feeds designed for drastic materials economy — Full details of operating data and designs

ARCHER E. KNOWLTON, Associate Editor "Electrical World"

EAST COAST consumers are to have their scant wartime petroleum products amplified by means of the world's largest and longest pipe line, familiarly known as the "Big Inch" because the 24-in. diameter is double the 12-in. maximum of previous practice and five times the capacity. It reaches nearly 1,600 miles from Longview, Tex., to the junction point for the relatively short 20-in. branches to Bayonne and Philadelphia areas. Electrically it means for the power industry a high-load-factor load of more than 130,000 hp. and an annual kilowatt-hour input of better than ¾ billion. Annual revenue to the utilities at 90 percent load factor promises to be $6,000,000 or more.

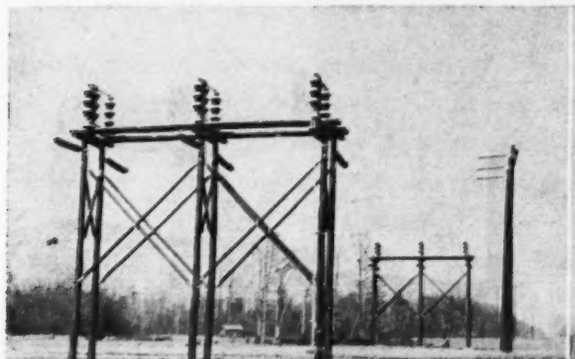
Each of the 25 standard pumping stations will have three 1,500-hp., four-pole induction motors of 95 percent efficiency and 92 percent power factor to drive the series-arranged centrifugal pumps. They will move the oil at 4.5 miles per hour under 725-740 psi. so as to deliver 300,000 barrels per day at full operation. It will take 4,000,000 barrels just to fill the pipe line.

To serve this load 15 power companies and War Emergency Pipelines, Inc., have built a total of 200 miles of line, of which 82 was 110 kv., 78 was 66-69 kv., 23 was 33 kv. and 17 was 22-25 kv. All used wood poles in either single-pole or H-frame construction.

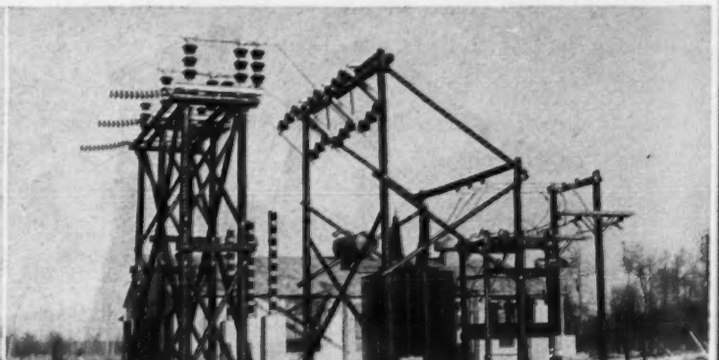
Title to the pipe line and the 26 pumping stations and step-down (to 2,300-volt) substations rests in the Defense Plant Corporation, but the job is being executed without profit by War Emergency Pipelines, Inc., an association of eleven oil companies. The objective is to match the capacity of some 30,000 railroad tank cars and to augment by 300,000 barrels a day the 800,000 barrels which the tank-car trains have been moving to the East. The pipe is ⅜ in. thick (½ in. at the 30 river crossings), comes in 40-ft. lengths, ⅛ mile to a gondola, and requires nearly 200,000 welded joints and 3,780,000 cu.yd. of 3x4-ft. trenching. It is double-coated by a taping machine to guard against corrosion and electrolytic attack.

Power Supply

Preliminary estimates showed that electrical powering of the pumping would be by far the cheapest in initial and annual cost. Steam units were estimated to cost five times as much as the electrical and internal combustion engines about four times as much. Each alternative method would have occasioned much more operating labor, it would have entailed provision of condensing or cooling water and, in addition, the oil-engine method would have involved taking high-priced fuel out of



SWITCHING STRUCTURES for lines to station 7 (foreground) and station 8 (background)



OUTDOOR METERING and 110-kv. fuse protection for transformers at 110/2.3-kv. substation at pumping station No. 7

the line for plant operation. The pipe line industry generally has gone to electrical drives wherever the practically 100 percent load factor can earn a kilowatt-hour rate that gets down to values between 6 and 7 mills. Further, the flexibility as to output is superior with three pumps in series because the operation of only two or one can be effected much more readily than the speed adjustment of steam or oil engine units.

Motor Load

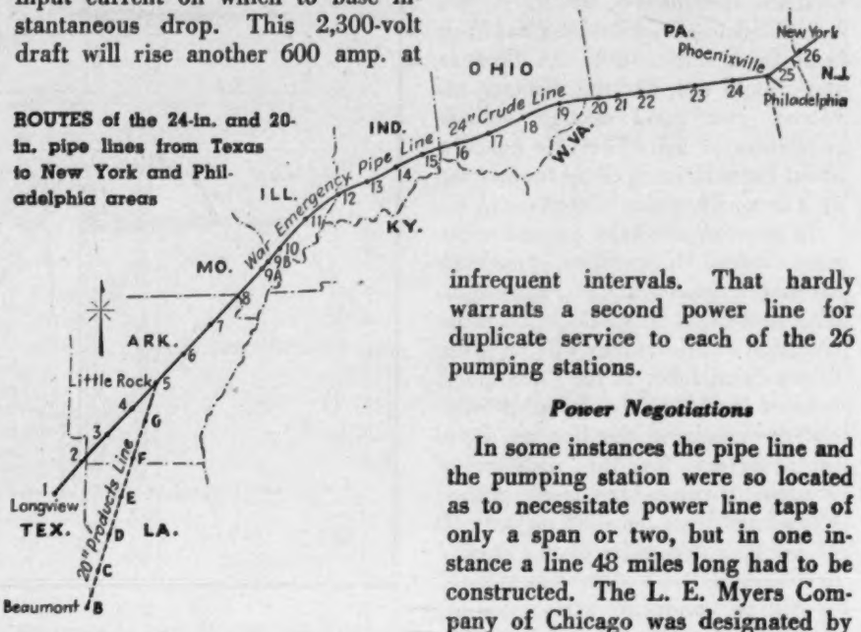
Motors applied to the main and auxiliary pumps total over 130,000 hp., of which the 84 of 1,500 hp. comprise 126,000 hp. There are eight auxiliary booster pumps amounting to 2,000 hp., miscellaneous suction, sump, delivery and loading-rack pumps. There is also a 1-hp. motor to drive the fan which ventilates each of the main pump motors to dissipate the 75 hp. of loss entailed at the 95 percent efficiency of the design.

The problem of designing the lines to serve this load was essentially one of doing it with available materials, yet adequately to carry the load of two motors operating at full capacity and in addition the starting current of the third motor without introducing too much voltage drop. Only one circuit was provided in each instance.

Since the designs were established (Table II) decision has been made to add a 20-in. "products" line, and this is now being installed on the same right-of-way except for the southeastern end. It will have separate pumping stations, but be fed over the same power lines and through adjoining substations. This line will handle an additional 235,000 barrels a day and will raise the total electrical requirements from 4,500 to some 8,250 hp. at each double pumping station. Any checking of the data given in the table should be done, therefore, in the knowledge that all the quantities are given exclusively for the 24-in. pipe line load, but that actual ultimate operating currents may be 75 percent greater than the table implies. Of course, only one motor would be started at a time even with two pumping stations served by a given line at a given location.

Operating Conditions

Each of the 1,500-hp., 2,300-volt motors takes 325-333 amp. at full load and 92 percent power factor. That makes about 1,000 amp. per pumping station on the 24-in. line when auxiliaries are also included. Starting current across-the-line is about five times normal; this means 1,600 amp. for a single motor, and, added to the 650 for two motors already operating makes a 2,250-amp. input current on which to base instantaneous drop. This 2,300-volt draft will rise another 600 amp. at



ROUTES of the 24-in. and 20-in. pipe lines from Texas to New York and Philadelphia areas

stations 5 to 26 when the three 24-in. motors and two 20-in. motors are operating and the third 20-in., 3,600-r.p.m. motor with 600 percent starting current is started. These across-the-line conditions apply at fourteen of the stations. The remaining twelve stations have 65 percent taps on compensator starters and will draw at starting only 210 percent of full-load current.

Incidentally, operation of two pumps at each 24-in. station will result in delivery of 83 percent of the 300,000 barrel-per-day capacity; one pump at each station will reduce output to 55 percent. On the other hand, the non-operation of one entire 24-in. pumping station will reduce the output of the whole line by some 35 percent until repairs to line or pumping equipment can be made. The loss of the corresponding 100,000 barrels per day represents a loss of some $1,500 per hour at expectedly infrequent intervals. That hardly warrants a second power line for duplicate service to each of the 26 pumping stations.

Power Negotiations

In some instances the pipe line and the pumping station were so located as to necessitate power line taps of only a span or two, but in one instance a line 48 miles long had to be constructed. The L. E. Myers Company of Chicago was designated by W.E.P. as prime contractor and designed and installed all 26 substations. Its staff also designed and built the transmission lines serving pumping stations 1-11 at the southern end. Cost of these lines was borne by W.E.P. on DPC funds.

Negotiation for the locations of pumping station substations, for the provision of the power circuits and for the power contracts was carried on by W. H. Stueve of the Oklahoma Gas & Electric Company in his capacity as electric power consultant on the W.E.P. staff. Stueve was also liaison agent for W.E.P. with PAW, WPB and DPC in Washington; he assisted in design and approved all

Table I—Copper in Substation Bus and Equipments (Lb.)

Sta.	Buses & Misc. Wiring	Transformers	Primary Grounds	Primary Air Breaker	Fuse Mtgs.	Secondary Grounds	Secondary Air Breaker	Secondary Transformer	Total
1	981.2	3,560	260	270	4	50	162	184	5,471.2
2	981.2	3,560	260	270	4	50	162	184	5,471.2
3	981.2	3,700	260	508	4	50	162	184	5,849.2
4	981.2	3,700	260	508	4	50	162	184	5,849.2
5	981.2	3,700	260	508	4	50	162	184	5,849.2
6	981.2	3,700	260	508	4	50	162	184	5,849.2
7	981.2	3,700	260	508	4	50	162	184	5,849.2
8	981.2	3,700	260	508	4	50	162	184	5,849.2
9A	493.6	3,040	260	163	4	50	162	184	4,356.6
9B	981.6	3,560	260	270	4	50	162	184	5,471.6
10	981.6	3,560	260	270	4	50	162	184	5,471.6
11	1,467.1	4,980	520	270	8	50	162	184	7,641.1
Grand total									68,978.5

power line and substation construction.

Originally it was intended to conserve copper by using steel conductors throughout. But when the 20-in. "products" pipe line entered the picture it became necessary to use either copper, ACSR or Copperweld conductors for stations 7, 8, 12-26. Steel conductors ($\frac{1}{2}$ in. HTC-130) were used for stations 1-6, 9B-11. A No. 1/0 ACSR line 55 miles long has been built from station 8 to 9A because steel would not, for the distance involved, give good enough voltage regulation at 9A. There is concern about the sufficiency of this conductor on a corona basis on 110 kv.

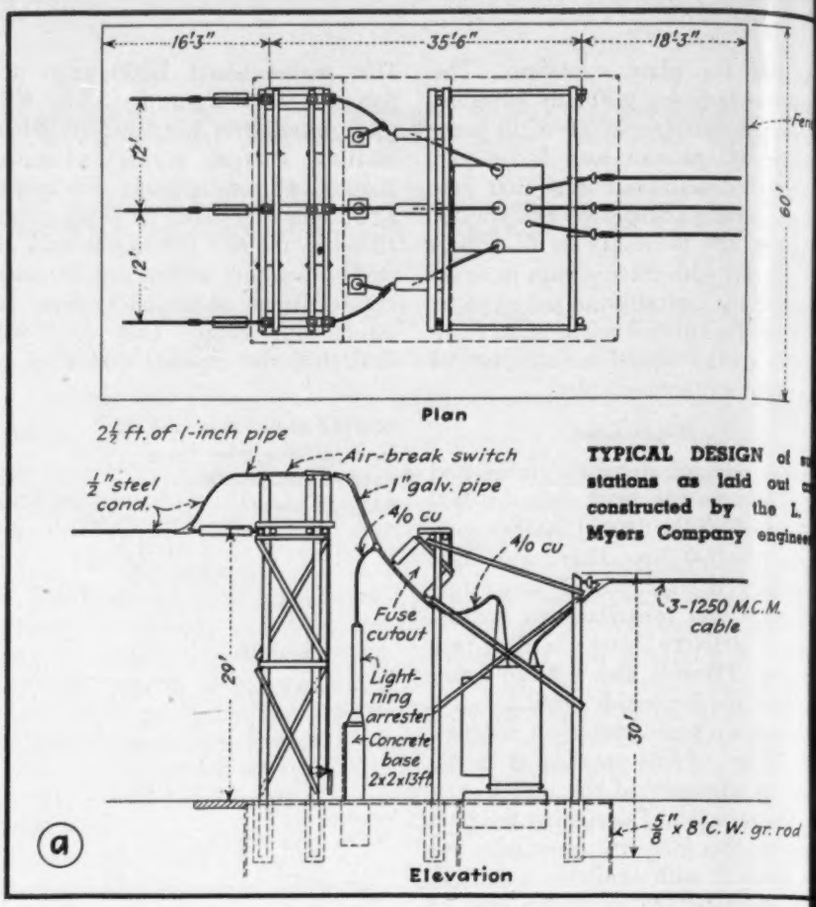
In general, overhead ground wires were omitted. If operating experience shows the desirability of better lightning protection it is said to be probable that consideration will be given to expulsion tubes in the "hot spots" because these can be installed without de-energizing the line as would be necessary for the addition of ground wires. Overhead ground wires have been installed on only 22 of the total 200 miles of tap lines.

No arcing horns were reported and, of course, conductor armor was applied only in the case of the three ACSR lines.

Substations

Terminal structures and substations were provided at all pumping stations by W.E.P. and consequently the protective features were largely under the control of the pipe line customer. No telemetering or supervisory control is reported.

Metering structures were provided by W.E.P., but the metering as kilowatt-hours, reactive and dema will follow the practice of the resp tive utilities for loads of this classi cation. One instance reports t application of compensating meteri

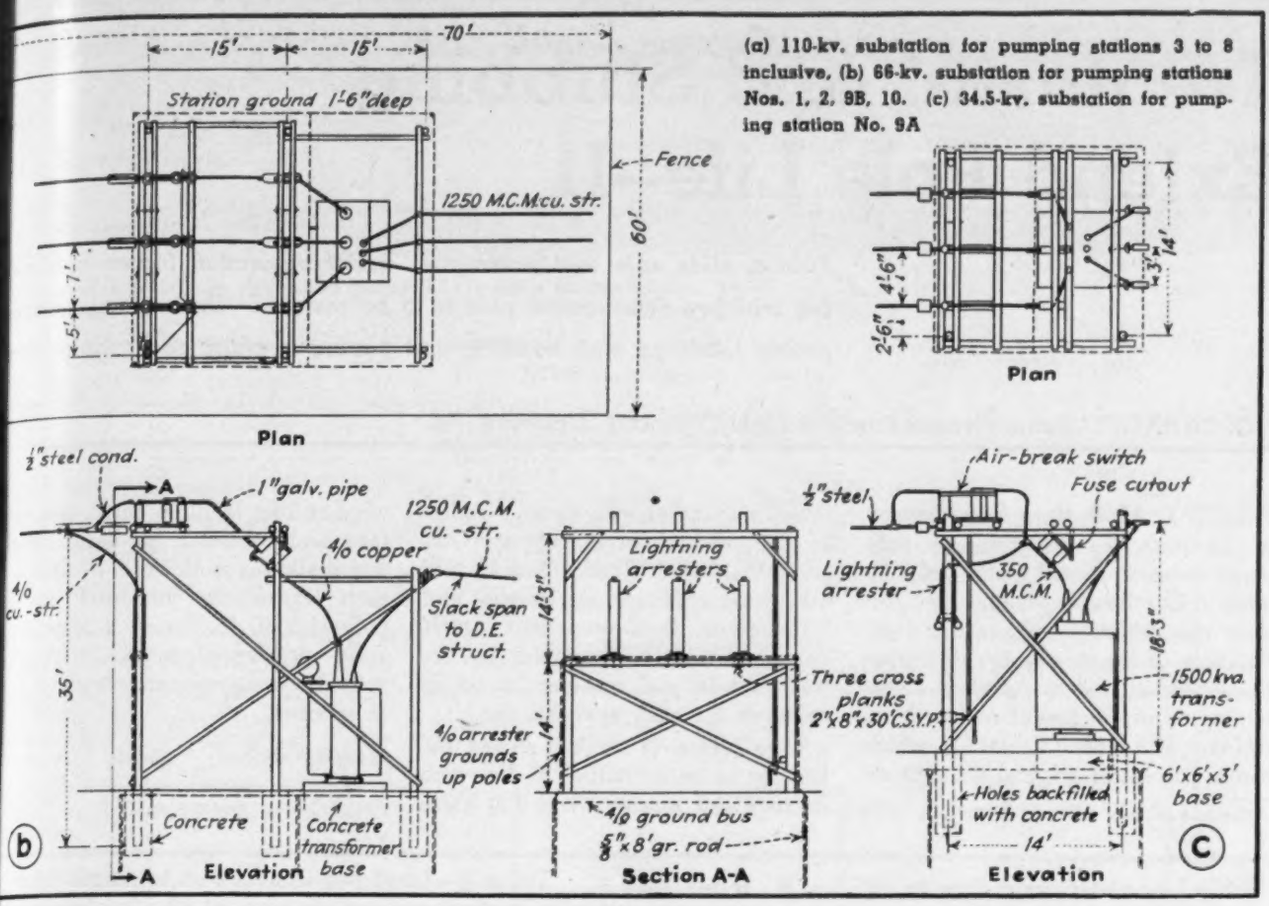


TYPICAL DESIGN of s stations as laid out a constructed by the I. Myers Company enginee

Table II—Design Information for Power

1. Utility Company	Southwestern Gas and Electric Co.		Arkansas Power & Light Co.				Arkansas-Missouri Power Company		Missouri Utilities	Central Ill. Public S	
2. Pumping station No.	1	2	3	4	5	6	7	8	9A	9B	10
3. Total pump horsepower	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	1,500	3,000	4,500
4. Peak oper. amps. at 2.3 kv.	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	325	650	1,000
5. Starting voltage	Full	Full	Full	Full	Full	Full	Full	Full	Reduced	Reduced	Reduced
6. Max. starting amps. at 2.3 kv.	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	.....	.....	.....
7. Designed voltage reg'n (%)	.....	.....	.....	.....	.....	.....	2	3	1.0	.....	.....
8. Length of supply line (miles)	0.65	2.4	7.06	11.55	0.1	1.66	13.05	48.41	0.25	18.21	8.85
9. Supply line voltage (kv.)	66	66	110	110	110	110	110	110	33	66	66
10. Rating of transformer bank (kva)	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	1,500	2,500	3,750
11. Type of line conductor	Steel	Steel	Steel	Steel	Steel	Steel	See Note A	See Note B	Steel	Steel	Steel
12. Size of line conductor	½-in.	HTC-130	½-in.	½-in.	½-in.	½-in.			½-in.	½-in.	HTC-130
13. Equiv. spacing of conductors (ft.)	8.5	8.5	18	18	18	18	18	18	4.5	8.5	8.5
14. Normal span length (ft.)	350	350	600	600	600 (Des.)	600	600	600	300	350	350
15. Max. span length (ft.)	406	400	880	1,290	290	701	764	760	300	1,250	600
16. Normal sag. (ft. of 60 F.)	2.89	2.89	9.2	9.2	9.2	9.2	11.3/9.2	9.17/11.77	3.5	2.89	2.89
17. Type of line structure	CSYP pole		Creosoted sou. yel. pine H-frames				CYSP H-frame		Pole 35 ft.	CSYP pole	CSYP pole
18. Pole size and class	45-ft., 8–9 in. top		50-ft., 8–9-in. tops				50-ft., 8–9 in. tops		CL. 4	55-ft.	55-ft.
19. Height to lowest conductor (ft.)	29	29	35.6	35.6	35.6	35.6	35.6	35.6	29	33.6	33.6
20. Type of crossarm	Fir	Fir	CSYP SPAR	CSYP SPAR	CSYP SPAR	CSYP SPAR	CSYP SPAR	CSYP SPAR	8 ft. fir	2 fir	2 fir
21. Size of crossarm	10 ft.	10 ft.	30 ft.	30 ft.	30 ft.	30 ft.	.....	.....	4x5 in.	10 ft.	10 ft.
22. Insulator pins, material	.....	.....	.....	.....	.....	.....	.....	.....	Steel	.....	.....
23. Straight run ins. units (No.)	5	5	6	6	6	6	6	6	.....	4	5
24. Straight run ins. units (rating)	15,000 lb.	15,000 lb.	15,000 lb.	15,000 lb.	15,000 lb.	15,000 lb.	15,000 lb.	15,000 lb.	45 kv.	15,000 lb.	15,000 lb.
25. Dead-end ins. units (No.)	6	6	12	12	12	12	12	12	.....	5	6
26. Dead-end ins. units (rating)	25,000 lb.	25,000 lb.	25,000 lb.	25,000 lb.	25,000 lb.	25,000 lb.	25,000 lb.	25,000 lb.	.....	15,000 lb.	25,000 lb.
27. Overhead ground wire (nat'l)	None	None	None	None	None	None	None	None		None	Steel
28. Overhead ground wire (size)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	⅜ in.
29. Designed term. grd. res. (ohms)	.....	.....	.....	.....	.....	.....	Ungrounded delta		0.5	.....	.....
30. Designed line grd. res. (ohms)	.....	.....	.....	.....	.....	.....	Ungrounded delta		.....	.....	.....

* Also 7½ miles of 132 kv. on 65-ft. H-frame with Hughes Bros. cross braces and 30-ft.x10x3-in. CSYP timber arms. Note A — Copperweld (0.522)



o translate the input to line values. Metering on the first eleven stations s at 2,300 volts.

Wood was used exclusively for the ubstation structures and every effort as made to keep the use of copper to a minimum. The tabulation (Table I) for the initial eleven stations shows about 69,000 lb. of copper required for the substation buses, transformers (primary and auxiliary), grounds, equipments and mountings. This represents about 1.4 lb. per horsepower of 2,300-volt capacity.

Details of interior electrical arrangements at the pumping stations are presented on page 126.

ng Pipe Line Pumping Stations

blic Service Company of Indiana			Cincinnati Gas & Elec.	Columbus & So. O. Elec.	Ohio Power Co.		West Penn Power		Penn. Electric	Potomac Edison	Penn Power & Light	Phila. Elec.	New Jersey P. & L.
13	14	15	16	17	18	19	20	21	22	23	24	25	26
4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	5,000	5,000
1,000	1,000	1,000	1,000	.....	1,000	1,000	1,000	1,000	1,000	1,000	1,000	.....	970
Reduced	Full	Reduced	Full	Full	Full	Full	Reduced	Full	Reduced	Full	Full	Reduced	Reduced
.....	.....	.....	1,625	.....	1,600	1,600	1,200	1,500	1,940	1,500	.....	.....	670
5	0.5	3	3	.....	0.18	2.2	10	5	10	.....	.....	8-9	8.5
7	1	3	8	16.49	1.4	16	12*	2	3.5	0.5	4.5	10	1.0
33	66	33	66	69	69	69	25	25	22	69	66	33	33
3,750	3,750	.....	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750
Copper	Copper	Copper	HDBC	CuCW	ACSR	ACSR	Copper	Copper	Copper	Copper	Copper	CuCW	ACSR
No. 2	No. 2/0	No. 4	No. 2	⅜ in. 30%	No. 2	No. 2	No. 1/0	No. 1/0	No. 2/0	No. 1/0,	41,740 c.m.	No. 1/0	No. 3/0
.....	.....	.....	.....	.....	6.95	6.95	.....	.....	.....	.....	.....	.....	.....
220	300	220	220	.....	350	350	.....	.....	250	300	450 (Est.)	250	300
275	350	250	260	400	.....	.....	.....	.....	550	300	600 (Est.)	300	336
3.5	4.5	4.5	2 2/3	3	.....	.....	.....	.....	3	4.29	9.5	.....	3.7
Pole	Pole	Pole	Pole	Pole	No. 4 cedar	No. 4 cedar	CL. 3 cedar	CL. 3 pole	CL. 4 cedar	CL. 2 pole	H- frame	CL. 2 pole	CL. 3 pole
40 ft. CL. 5	55 ft. CL. 4	40 ft. CL. 5	50 ft. 9 in.	50-75 ft.	50-65 ft.	50-75 ft.	65 ft.	35 ft.	35 ft.	55 ft.	60 ft. CL. 2	45-55 ft.	40-50 ft.
25	27	25	31	31¼	25	25	28	28	28	30.5	25	25	33
Wood	Spar	Wood	9 ft. wood	Fir	Fir, 9 ft.	Fir, 9 ft.	Fir	Fir	Wood	10 ft. fir	Fir	Wood	Wood
.....	.....	.....	4x6 in.	4x5 in.	4¾x5¾	4¾x5¾	10 ft. Steel	10 ft. Steel	.....	4x5 in.	.....	.....	.....
Steel	.....	Steel	.....	.....	.....	.....	.....	.....	Steel	.....	.....	Steel	Steel
.....	5	.....	5	5	5	5	.....	.....	.....	5	4	.....	.....
45 kv.	10-in.	45 kv.	10x5¾	75 kv.	15,000 lb.	15,000 lb.	45 kv.	45 kv.	34.5	10-in.	15,000 lb.	125 kv. DFO	45 kv.
4	6	4	6	6	6	6	4	4	3	6	6	5	4
10-in.	10-in.	10-in.	10x5¾	90 kv.	15,000 lb.	15,000 lb.	15,000 lb.	15,000 lb.	5¾x10 in.	10-in.	15,000 lb.	330 kv. DFO	15 kv.
None	Steel No. 4 BWG	None	CW 3 No. 8	None	None	None	None	None	None None	None None	GW 3 No. 7 EHS	None	None
.....	.....	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	20	.....	15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

½-in. steel 4.5 miles. Note B — Type F No. 2/0 CuW for 16.41 miles and ½-in. 40 percent Copperweld for 32 miles.

power line and substation construction.

Originally it was intended to conserve copper by using steel conductors throughout. But when the 20-in. "products" pipe line entered the picture it became necessary to use either copper, ACSR or Copperweld conductors for stations 7, 8, 12-26. Steel conductors ($\frac{1}{2}$ in. HTC-130) were used for stations 1-6, 9B-11. A No. 1/0 ACSR line 55 miles long has been built from station 8 to 9A because steel would not, for the distance involved, give good enough voltage regulation at 9A. There is concern about the sufficiency of this conductor on a corona basis on 110 kv.

In general, overhead ground wires were omitted. If operating experience shows the desirability of better lightning protection it is said to be probable that consideration will be given to expulsion tubes in the "hot spots" because these can be installed without de-energizing the line as would be necessary for the addition of ground wires. Overhead ground wires have been installed on only 22 of the total 200 miles of tap lines.

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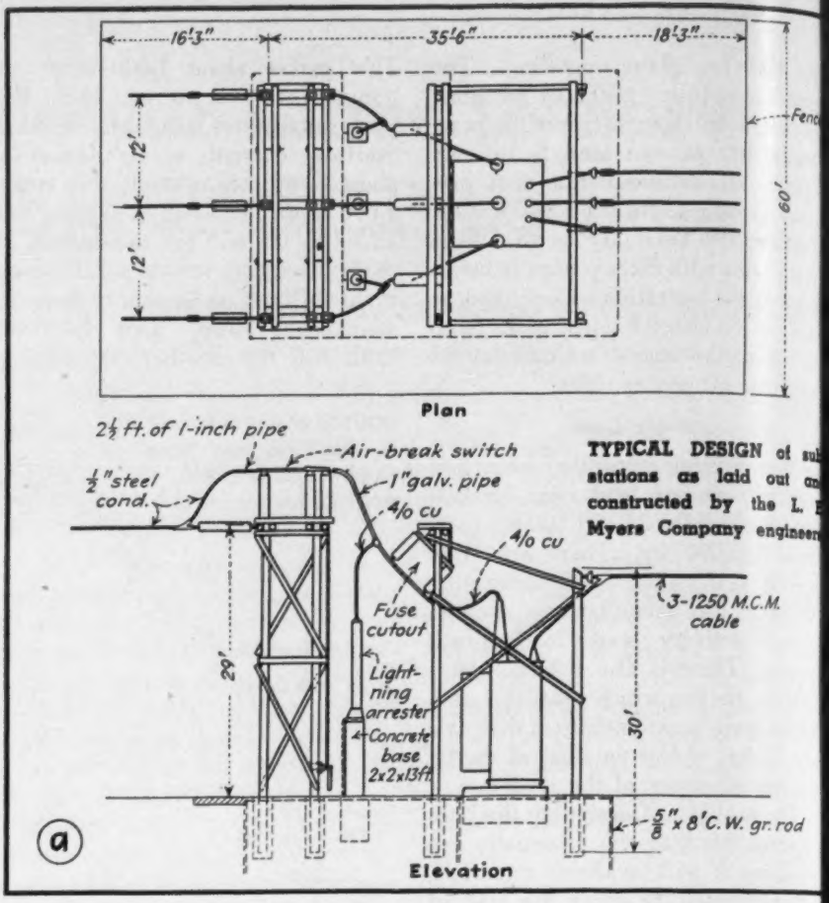


TYPICAL DESIGN of sub stations as laid out an constructed by the I. Myers Company engineers

Substations

Terminal structures and substations were provided at all pumping stations by W.E.P. and consequently the protective features were largely under the control of the pipe line customer. No telemetering or supervisory control is reported.

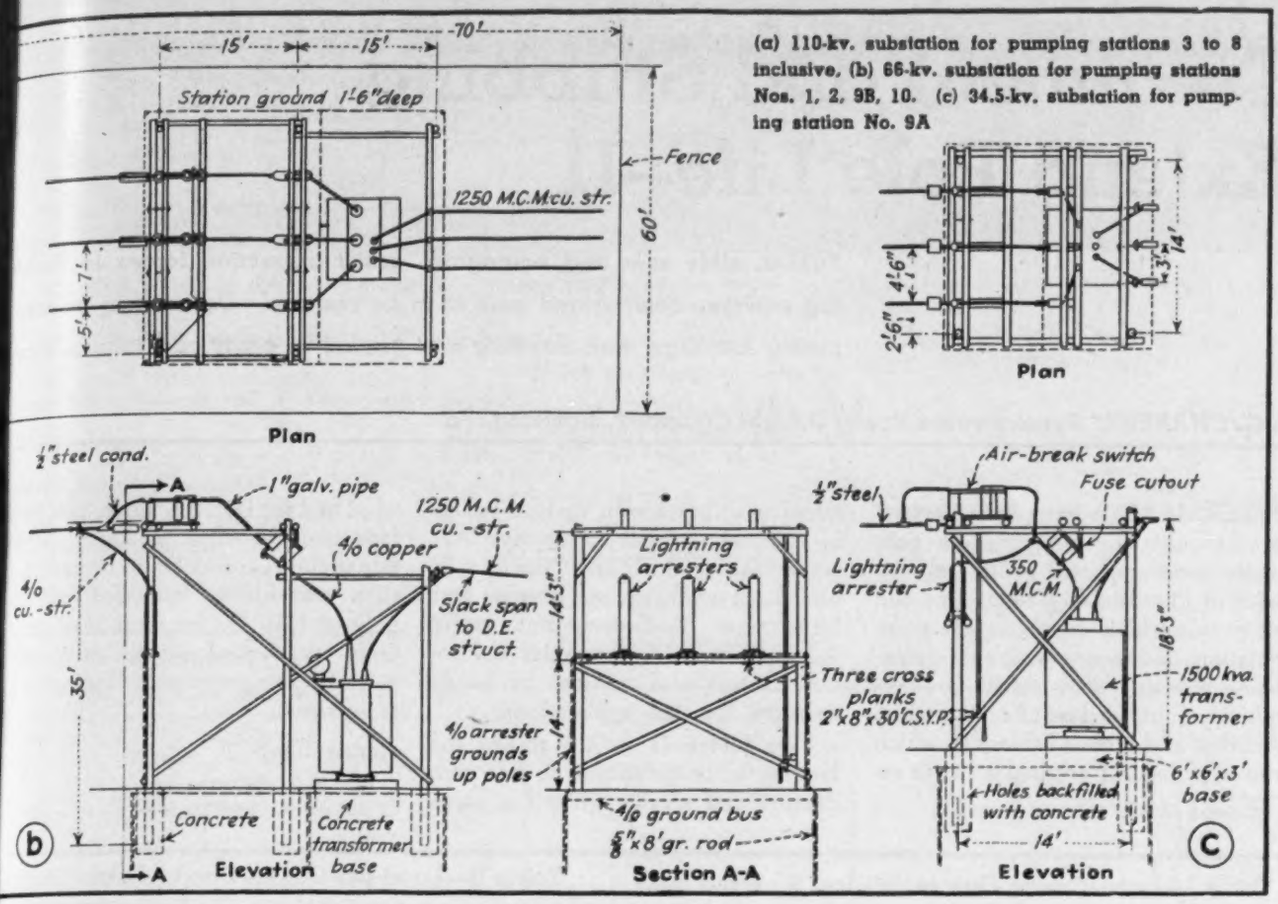
Metering structures were provided by W.E.P., but the metering as t kilowatt-hours, reactive and deman will follow the practice of the respec tive utilities for loads of this classifi cation. One instance reports th application of compensating meterin

Table II—Design Information for Power

1. Utility Company	Southwestern Gas and Electric Co.		Arkansas Power & Light Co.				Arkansas-Missouri Power Company		Missouri Utilities	Central Ill. Public Se	
2. Pumping station No.	1	2	3	4	5	6	7	8	9A	9B	10
3. Total pump horsepower	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	1,500	3,000	4,500
4. Peak oper. amps. at 2.3 kv	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	325	650	1,000
5. Starting voltage	Full	Full	Full	Full	Full	Full	Full	Full	Reduced	Reduced	Reduced
6. Max. starting amps. at 2.3 kv	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	.....	.....	.....
7. Designed voltage reg'n (%)	.....	.....	.....	.....	.....	.....	2	8	1.0	.....	.....
8. Length of supply line (miles)	0.65	2.4	7.06	11.55	0.1	1.66	13.05	48.41	0.23	18.21	8.85
9. Supply line voltage (kv.)	66	66	110	110	110	110	110	110	33	66	66
10. Rating of transformer bank (kva)	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	1,500	2,500	3,750
11. Type of line conductor	Steel	Steel	Steel	Steel	Steel	Steel	See	See	Steel	Steel	Steel
12. Size of line conductor	½-in.	HTC-130	½-in.	½-in.	½-in.	½-in.	Note A	Note B	½-in.	½-in.	HTC-130
13. Equiv. spacing of conductors (ft.)	8.5	8.5	18	18	18	18	18	18	4.5	8.5	8.5
14. Normal span length (ft.)	350	350	600	600	600 (Des.)	600	600	600	300	350	350
15. Max. span length (ft.)	406	400	880	1,290	290	701	764	760	300	1,250	600
16. Normal sag. (ft. of 60 F.)	2.89	2.89	9.2	9.2	9.2	9.2	11.3/9.2	9.17/11.77	3.5	2.89	2.89
17. Type of line structure	CSYP pole		Creosoted sou. yel. pine H-frames				CYSP H-frame		Pole 35 ft.	CSYP pole	CSYP pole
18. Pole size and class	45-ft., 8–9 in. top		50-ft., 8–9-in. tops				50-ft., 8–9 in. tops		CL. 4	55-ft.	55-ft.
19. Height to lowest conductor (ft.)	29	29	35.6	35.6	35.6	35.6	35.6	35.6	29	33.6	33.6
20. Type of crossarm	Fir	Fir	CSYP SPAR	CSYP SPAR	CSYP SPAR	CSYP SPAR	CSYP SPAR	CSYP SPAR	8 ft. fir	2 fir	2 fir
21. Size of crossarm	10 ft.	10 ft.	30 ft.	30 ft.	30 ft.	30 ft.	.....	.....	4x5 in. Steel	10 ft.	10 ft.
22. Insulator pins, material	.....	.....	.....	.....	.....	.....	.....	.....	.....	4	5
23. Straight run ins. units (No.)	5	5	6	6	6	6	6	6	.....	.....	.....
24. Straight run ins. units (rating)	15,000 lb.	15,000 lb.	15,000 lb.	15,000 lb.	15,000 lb.	15,000 lb.	15,000 lb.	15,000 lb.	45 kv.	15,000 lb.	15,000 lb.
25. Dead-end ins. units (No.)	6	6	12	12	12	12	12	12	.....	5	6
26. Dead-end ins. units (rating)	25,000 lb.	25,000 lb.	25,000 lb.	25,000 lb.	25,000 lb.	25,000 lb.	25,000 lb.	25,000 lb.	.....	15,000 lb.	25,000 lb.
27. Overhead ground wire (nat'l)	None	None	None	None	None	None	None	None		None	Steel
28. Overhead ground wire (size)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	⅜ in.
29. Designed term. grd. res. (ohms)	.....	.....	.....	.....	.....	.....	Ungrounded delta		0.5	.....	.....
30. Designed line grd. res. (ohms)	.....	.....	.....	.....	.....	.....	Ungrounded delta		.....	.....	.....

* Also 7½ miles of 132 kv. on 65-ft. H-frame with Hughes Bros. cross braces and 30-ft.x10x3-in. CSYP timber arms.

Note A — Copperweld (0.522) f



(a) 110-kv. substation for pumping stations 3 to 8 inclusive, (b) 66-kv. substation for pumping stations Nos. 1, 2, 9B, 10. (c) 34.5-kv. substation for pumping station No. 9A

to translate the input to line values. Metering on the first eleven stations is at 2,300 volts.

Wood was used exclusively for the substation structures and every effort was made to keep the use of copper to a minimum. The tabulation (Table I) for the initial eleven stations shows about 69,000 lb. of copper required for the substation buses, transformers (primary and auxiliary), grounds, equipments and mountings. This represents about 1.4 lb. per horsepower of 2,300-volt capacity.

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ublic Service Company of Indiana				Cincinnati Gas & Elec.	Columbus & So. O. Elec.	Ohio Power Co.		West Penn Power		Penn. Electric	Potomac Edison	Penn Power & Light	Phila. Elec.	New Jersey P. & L.
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	5,000	5,000
000	1,000	1,000	1,000	1,000	.....	1,000	1,000	1,000	1,000	1,000	1,000	1,000	.....	970
ed	Reduced	Full	Reduced	Full	Full	Full	Full	Reduced	Full	Reduced	Full	Full	Reduced	Reduced
...	.....	.....	.....	1,625	.....	1,600	1,600	1,200	1,500	1,940	1,500	.....	.....	670
3	5	0.5	3	3	.....	0.18	2.2	10	5	10	.....	.....	8-9	8.5
3	7	1	3	8	16.49	1.4	16	12*	2	3.5	0.5	4.5	10	1.0
33	33	66	33	66	69	69	69	25	25	22	69	66	33	33
750	3,750	3,750	.....	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750
per	Copper	Copper	Copper	HDBC	CuCW	ACSR	ACSR	Copper	Copper	Copper	Copper	Copper	CuCW	ACSR
4	No. 2	No. 2/0	No. 4	No. 2	⅜ in. 30%	No. 2	No. 2	No. 1/0	No. 1/0	No. 2/0	No. 1/0,	41,740 c.m.	No. 1/0	No. 3/0
...	.....	.....	.....	.....	.....	6.95	6.95	.....	.....	.....	.....	.....	.....	.....
220	220	300	220	220	.....	350	350	.....	.....	250	300	450 (Est.)	250	300
250	275	350	250	260	400	.....	.....	.....	.....	550	300	600 (Est.)	300	336
4.5	3.5	4.5	4.5	2 2/3	3	.....	.....	.....	.....	3	4.29	9.5	.....	3.7
le	Pole	Pole	Pole	Pole	Pole	No. 4 cedar	No. 4 cedar	CL. 3 cedar	CL. 3 pole	CL. 4 cedar	CL. 2 pole	H- frame	CL. 2 pole	CL. 3 pole
ft.	40 ft.	55 ft.	40 ft.	50 ft.	50-75 ft.	50-65 ft.	50-75 ft.	65 ft.	35 ft.	35 ft.	55 ft.	60 ft.	45-55 ft.	40-50 ft.
s	CL. 5	CL. 4	CL. 5	9 in.								CL. 2		
25	25	27	25	31	31¼	25	25	28	28	28	30.5	25	25	33
od	Wood	Spar	Wood	9 ft. wood	Fir	Fir, 9 ft.	Fir, 9 ft.	Fir	Fir	Wood	10 ft. fir	Fir	Wood	Wood
...	.....	.....	.....	4x6 in.	4x5 in.	4¾x5¾	4¾x5¾	10 ft.	10 ft.	.....	4x5 in.	.....	.....	.....
el	Steel	.....	Steel	.....	.....	.....	.....	Steel	Steel	Steel	.....	.....	Steel	Steel
...	.....	5	.....	5	5	5	5	.....	.....	.....	5	4	.....	.....
kv.	45 kv.	10-in.	45 kv.	10x5¾	75 kv.	15,000 lb.	15,000 lb.	45 kv.	45 kv.	34.5	10-in.	15,000 lb.	125 kv. DFO	45 kv.
4	4	6	4	6	6	6	6	4	4	3	6	6	5	4
in.	10-in.	10-in.	10-in.	10x5¾	90 kv.	15,000 lb.	15,000 lb.	15,000 lb.	15,000 lb.	5¾x10 in.	10-in.	15,000 lb.	330 kv. DFO	15 kv.
ne	None	Steel No. 4 BWG	None	CW 3 No. 8	None	None	None	None	None	None None	None None	CW 3 No. 7 EHS	None	None
...	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
...	.....	20	.....	15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

and ⅜-in. steel 4.5 miles. Note B — Type F No. 2/0 CuW for 16.41 miles and ½-in. 40 percent Copperweld for 32 miles.

Treatment and Stubbing Extend Pole Life—II

Tables, slide rule and nomogram assist inspection forces in deciding whether deteriorated pole is to be restored—Data given on computing loadings, stub banding and guying in chart and tabular form

J. G. CHAREST, Pennsylvania Power & Light Company, Hazleton, Pa.*

SEVERAL AIDS have been devised to facilitate the program of pole maintenance reported in the July 10 issue of ELECTRICAL WORLD. One is a slide rule which simplifies the computation of the adequacy of an existing pole as well as assists in determining required class of replacement. Another is a table (Table XI) which shows percent of original strength remaining in poles with various values of external and internal decay. Others are tables which show how to tabulate total wind, ice, service-wire and transformer loadings; unit stress values (Table IX); angular correction factors and number of bands required for stub applications.

Five tables (I to V) record the loading to be accredited to line conductors and service wires for given wind and ice loading, angle, pole surface and crossarm positions. Additional allowance of 75 lb. is made for each transformer mounted on the pole and 50 lb. for each mast arm. Only unbalanced service wires are considered in computing loadings due to services.

Assumption:

(a) 40-ft. chestnut pole.
(b) 150-ft. average span.

*Superintendent of lines and substations.

Table I—Load/Condr. Due to ½" Ice, 8" Wind (Lb.)

Size and Kind of Wire	100′ span	150′ span	200′ span	250′ span	300′ span	350′ span	400′ span	450′ span	500′ span
No. 6 Solid Bare Copper	78	116	155	194	233	271	310	349	388
No. 4 Solid Bare Copper	80	120	160	201	241	281	321	361	401
No. 2 Solid Bare Copper	84	126	167	210	252	294	336	378	420
No. 1 Solid Bare Copper	86	129	172	215	258	300	344	387	430
No. 2 Str. Bare Copper	86	129	172	215	259	302	345	388	431
No. 1 Str. Bare Copper	89	133	178	222	267	311	355	400	444
No. 1/0 Str. Bare Copper	92	137	183	229	275	320	366	412	458
No. 2/0 Str. Bare Copper	95	142	189	236	284	331	378	425	473
No. 3/0 Str. Bare Copper	98	147	196	245	294	343	392	441	490
No. 4/0 Str. Bare Copper	102	153	204	255	306	357	408	458	510
No. 6 Solid T.B.W.P.	89	133	177	221	266	310	354	399	443
No. 4 Solid T.B.W.P.	91	136	181	227	272	317	363	408	453
No. 2 Solid T.B.W.P.	96	144	192	240	288	336	383	431	479
No. 1 Solid T.B.W.P.	97	145	194	242	291	339	387	436	484
No. 1/0 Str. T.B.W.P.	107	161	214	268	321	375	428	482	536
No. 2/0 Str. T.B.W.P.	111	166	222	277	333	388	444	499	554
No. 4/0 Str. T.B.W.P.	119	179	238	298	357	417	476	536	595
No. 4 A.C.S.R.	84	126	168	210	251	293	335	377	419
No. 2 A.C.S.R.	88	132	176	219	263	307	352	395	439
No. 1 A.C.S.R.	90	136	181	226	271	316	361	407	452
No. 1/0 A.C.S.R.	93	140	186	233	280	326	372	420	466
No. 2/0 A.C.S.R.	97	145	193	241	290	338	386	434	483
No. 3/0 A.C.S.R.	100	150	200	250	300	350	400	450	500
No. 4/0 A.C.S.R.	104	156	208	260	312	365	417	469	521
No. 7A Str. Copperweld Cu.	82	123	163	204	245	286	326	367	408
No. 6A Str. Copperweld Cu.	82	123	164	205	246	287	328	369	410
No. 4A Str. Copperweld Cu.	86	129	172	215	258	301	345	387	430
Twisted Pair Tele. Wire	90	135	180	225	270	315	360	405	450
50 Pair Tele. Cable	115	170	230	290	345	400	460	520	575

Table II—Load per Condr. Due to Angle (Lb.)

Size and Kind of Wire	Break Angle 2°	4°	6°	8°	10°	12°	14°	15°
No. 6 Solid Bare Copper	22	43	65	87	108	130	151	162
No. 4 Solid Bare Copper	34	68	103	137	171	205	239	256
No. 2 Solid Bare Copper	55	109	163	218	272	326	380	406
No. 1 Solid Bare Copper	65	130	196	261	326	391	455	488
No. 2 Str. Bare Copper	55	109	163	218	272	326	380	406
No. 1 Str. Bare Copper	69	138	208	275	343	412	480	515
No. 1/0 Str. Bare Copper	70	140	210	279	349	418	487	522
No. 2/0 Str. Bare Copper	70	140	210	279	349	418	487	522
No. 3/0 Str. Bare Copper	70	140	210	279	349	418	487	522
No. 4/0 Str. Bare Copper	70	140	210	279	349	418	487	522
No. 6 Solid T.B.W.P.	22	43	65	87	108	130	151	162
No. 4 Solid T.B.W.P.	34	68	103	137	171	205	239	256
No. 2 Solid T.B.W.P.	55	109	163	218	272	326	380	406
No. 1 Solid T.B.W.P.	65	130	196	261	326	391	455	488
No. 1/0 Str. T.B.W.P.	70	140	210	279	349	418	487	522
No. 2/0 Str. T.B.W.P.	70	140	210	279	349	418	487	522
No. 4/0 Str. T.B.W.P.	70	140	210	279	349	418	487	522
No. 4 A.C.S.R.	45	91	136	181	227	272	316	340
No. 2 A.C.S.R.	60	120	181	241	301	332	386	414
No. 1 A.C.S.R.	70	140	210	279	349	418	487	522
No. 1/0 A.C.S.R.	74	148	222	296	370	444	516	554
No. 2/0 A.C.S.R.	70	140	210	279	349	418	487	522
No. 3/0 A.C.S.R.	70	140	210	279	349	418	487	522
No. 4/0 A.C.S.R.	70	140	210	279	349	418	487	522
No. 7A Str. Copperweld Cu.	58	116	174	231	289	347	404	432
No. 6A Str. Copperweld Cu.	54	108	162	216	270	324	376	404
No. 4A Str. Copperweld Cu.	75	151	226	302	377	453	526	564
Twisted Pair Tele. Wire	17	35	52	70	87	104	122	130
50 Pair Tele. Cable	70	140	210	279	349	418	487	522

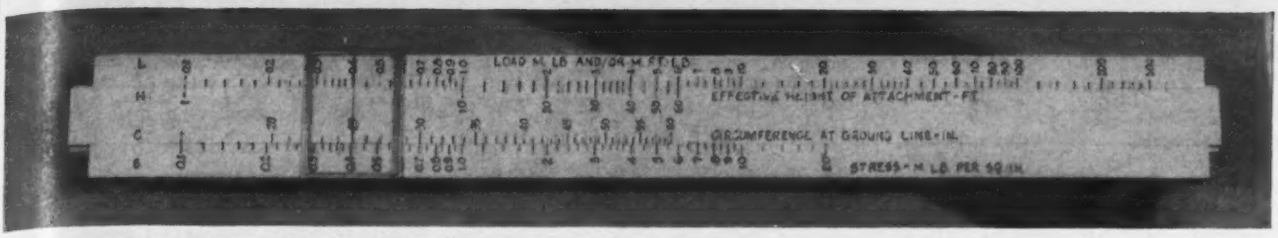


FIG. 1—Pole slide rule determines permissible loading of deteriorated pole

(c) 2 deg. break angle on pole.
(d) 3 No. 4 T.B.W.P., 100-ft. unbalanced service wires (unbalanced service wires are considered one crossarm position).
(e) one transformer.
(f) 3 No. 1 T.B.W.P. stranded primary conductors
(g) 1 No. 2 T.B.W.P. solid neutral conductor
(h) 2 No. 6 solid bare street lighting conductors
} 1 crossarm position

Table III—Additional Wind Loading for Pole Surface

Over-all Pole Height	Pounds	Over-all Pole Height	Pounds
25	91	50	185
30	111	55	203
35	127	60	221
40	147	65	239
45	167		

Table IV—Effective Height H of Moment Application

Over-all Pole Height	Number of Crossarm Positions				
	1	2	3	4	5
25	20	19	..	..	..
30	25	24	22	21	20
35	29	28	26	25	24
40	34	33	31	30	29
45	39	38	36	35	34
50	43	42	40	39	38
55	48	47	45	44	43
60	52	51	49	48	47
65	57	56	54	53	52

Table V—Pounds Load to Be Added for Each Unbalanced Service Wire

Size of Wire	Span in Feet 50	100
No. 6 TBWP	150	200
No. 4 TBWP	200	250

Table VI—Number of Acme Bands Required for Stubs

10-Ft. Stubs Set 6 Ft. 0 In.		12-Ft. Stubs Set 6 Ft. 6 In.	
No. of Bands Required	Bending Moment (Ft.-Lb.) Up to	No. of Bands Required	Bending Moment (Ft.-Lb.) Up to
1 At top		1 At top	
1 At bottom	35,000	1 At bottom	53,000
2 At top	35,001–	2 At top	53,001–
2 At bottom	70,000	2 At bottom	106,000
3 At top	70,001	3 At top	106,001
3 At bottom	and over	3 At bottom	and over

Calculation:

1. Wind load on wires from Table I:

	lb.
3 (No. 1/0 str. T.B.W.P., pri.) x 161	483
1 (No. 2 solid T.B.W.P., neut.) x 144	144
2 (No. 6 Solid bare copper—st. ltg.) x 116	232

2. Angle load on wires from Table II:

3 (No. 1/0 Str. T.B.W.P., pri.) x 70	210
1 (No. 2 Solid T.B.W.P., neut.) 55	55
2 (No. 6 Solid bare copper—st. ltg.) x 22	44

3 Wind on pole from Table III:

Wind on 40-ft. pole is	147

4. Load due to service wires from Table V:

3 Unbalanced service wires x 250	750

5. Load due to transformer

1 Transformer	75
Total load on pole	2,140

Slide Rule

The rule was designed to facilitate determining (a) whether a pole should be condemned because of inadequate strength and (b) ground line circumference of the pole or wood stub to be installed.

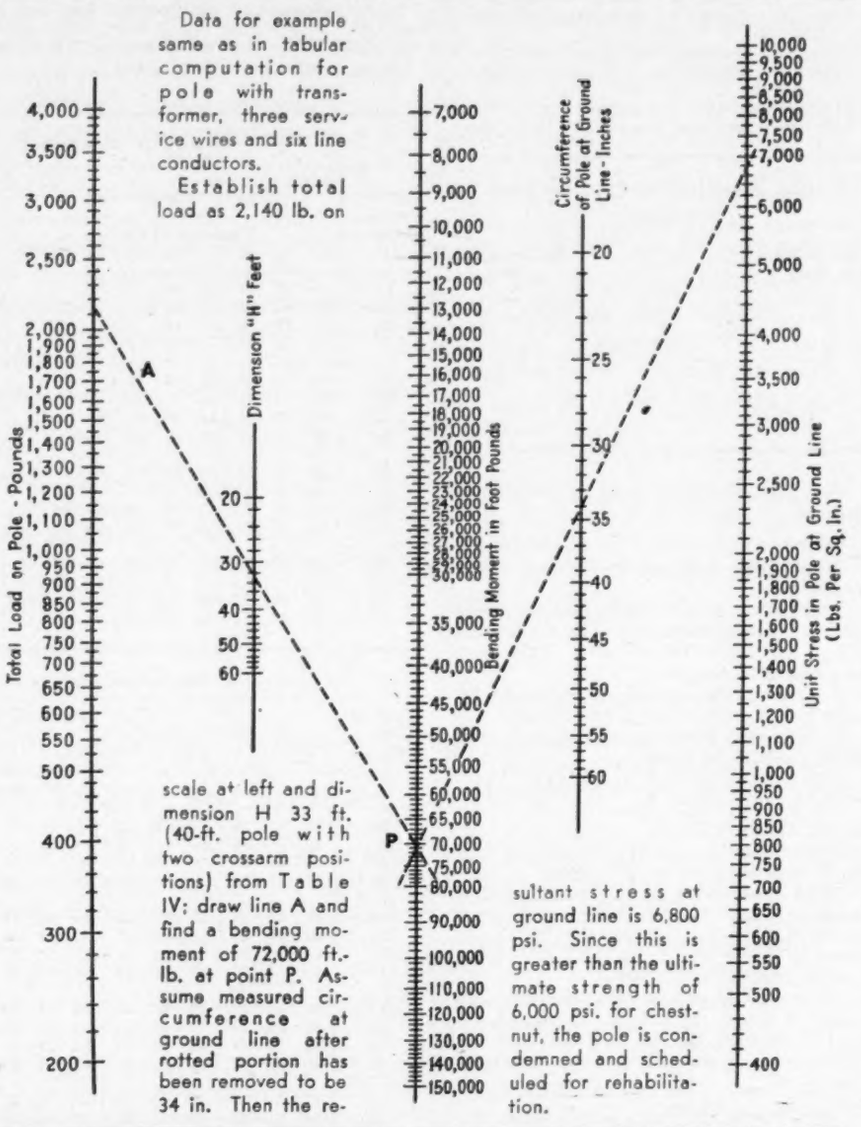

Data for example same as in tabular computation for pole with transformer, three service wires and six line conductors.
Establish total load as 2,140 lb. on scale at left and dimension H 33 ft. (40-ft. pole with two crossarm positions) from Table IV; draw line A and find a bending moment of 72,000 ft.-lb. at point P. Assume measured circumference at ground line after rotted portion has been removed to be 34 in. Then the resultant stress at ground line is 6,800 psi. Since this is greater than the ultimate strength of 6,000 psi. for chestnut, the pole is condemned and scheduled for rehabilitation.
Total Load on Pole - Pounds
Dimension "H" Feet
Bending Moment in Foot Pounds
Circumference of Pole at Ground Line - Inches
Unit Stress in Pole at Ground Line (Lbs. Per Sq. In.)
A
P

FIG. 2—Alignment chart gives resultant stress

Table VII—Number of Samson No. 1 Bands or Cable Lashing Required for Stubs

10-Ft. Stubs Set 6 Ft. 0 In.		12-Ft. Stubs Set 6 Ft. 6 In.	
No. of Bands Required	Bending Moment (Ft.-Lb.)	No. of Bands Required	Bending Moment (Ft.-Lb.)
1 At top 1 At bottom	Up to 58,000	1 At top 1 At bottom	Up to 88,000
2 At top 2 At bottom	58,001–116,000	2 At top 2 At bottom	88,001–176,000
3 At top 3 At bottom	116,001 and over	3 At top 3 At bottom	176,001 and over

Table VIII—Number of Samson No. 2 Bands Required for Stubs

10-Ft. Stubs Set 6 Ft. 0 In.		12-Ft. Stubs Set 6 Ft. 6 In.	
No. of Bands Required	Bending Moment (Ft.-Lb.)	No. of Bands Required	Bending Moment (Ft.-Lb.)
1 At top 1 At bottom	Up to 50,000	1 At top 1 At bottom	Up to 76,000
2 At top 2 At bottom	50,001–100,000	2 At top 2 At bottom	76,001–152,000
3 At top 3 At bottom	100,001 and over	3 At top 3 At bottom	152,001 and over

Table X—Stubbing of Guyed Poles

No. of ½-In. H.S. Steel Guys	No. of Bands on Stub
1	1 At top 1 At bottom
2	2 At top 2 At bottom
3 or more	3 At top 3 At bottom

(a) Determining if pole is to be condemned.

Known conditions:

1. Loading is 2,140 lb. (from above example).
2. Effective height above ground (lever arm) at which these forces act is 33 feet shown on Table IV for 40-ft. pole with two crossarm positions.
3. Ground line circumference is 34 in. after rotted portion has been removed.
4. Maximum allowable unit stress in psi. from Table IX is 6,000.

Calculations by Slide Rule (Fig. 1):

Place 1 of "H" scale directly under 2.14M lb. of "L" scale.

Move window to 34 on "H" scale. (72 M ft.-lb. may be read on "L" scale.)

With the window in this position, slide scale "C" until 34 (the circumference) is under the hair line. On the "S" scale, directly under the index 1 of "C" scale, can be read 6,800 psi. stress.

Since this is greater than the allowable 6,000 lb. stress, the pole is condemned.

(b) Determining the ground line circumference of the pole or wood stub to be installed.

Known conditions:

1. New pole or stub to be treated, pine.
2. Height to be 40 ft.
3. New pole to have factor of safety of 2.
4. Maximum allowable stress not to exceed 3,700 psi. from Table IX.

Place window hair line on 72 M ft.-lb. on scale "L," the total bending moment previously determined. Place index 1 of "C" scale directly above 3,700 of "S" scale. Then the required ground line circumference of the new pole or stub is found on "C" scale under the hair line to be 41.5 in. By referring to standard tables for new poles it can be found that this requires a class 1 pole.

The alignment chart, shown as Fig. 2, serves the same purpose as the slide rule and may be used to determine the bending moment, the resultant unit stress and required circumference.

Three tables (VI, VII, VIII) indicate the number of bands to use for various lengths, depths of setting and computed bending moments. Another table (X) indicates what stub-bands are required for guyed poles. Where ⅞-in. through-bolts are used one is installed at the top and one at the bottom for all conditions.

Table IX—Unit Stresses Based on A.S.A. Specifications

*Unit Stress — Pounds per Sq. In.

Kind of Pole	"A" Factor of Safety =0.67	"B" Factor of Safety =1.0	"C" Factor of Safety =1.3	"D" Factor of Safety =1.5	"E" Factor of Safety =3.0	"F" Factor of Safety =4.0
Chestnut	9,000	6,000	4,600	4,000	3,000	1,500
Cedar	8,000	5,600	4,310	3,730	2,800	1,400
Pine	11,000	7,400	5,700	4,930	3,700	1,850

"A" = Condemned by distribution if less than 0.67. "B" = Condemned by transmission if less than 1.00. "C" = New pole — Rural distribution, 1.30. "D" = New pole — Urban distribution, 1.50. "E" = New pole — Transmission, 2.00. "F" = New pole — Unguyed — G. O. No. 13, 4.00.

* Based on ½-in. ice and 8-lb. wind.

Table XI—Strength of Pole in Percent of Original Strength

Original Circumference	Due to External Decay — Thickness of Decay									Due to Internal Decay — Thickness of Solid Shell									Original Circumference
	¼	½	¾	1	1¼	1½	1¾	2	2¼	½	1	1½	2	2½	3	3½	4	4½	
24	82	65	52	40	30					43	70	86	95	98					24
26	83	68	55	44	34					40	67	83	93	98					26
28	84	70	58	47	37					38	64	81	91	96					28
30	85	72	60	50	40	32				36	61	78	89	95					30
32	86	73	62	52	43	35				34	58	75	86	93	97				32
34	87	75	64	54	46	38				32	56	73	84	92	96				34
36	87	76	66	56	48	40	33			30	54	70	82	90	95				36
38	88	77	67	58	50	42	36			29	51	68	80	88	94	97			38
40	89	78	69	60	52	45	38			28	49	66	78	87	92	96			40
42	89	79	70	62	54	47	40	34		27	47	64	76	85	91	95			42
44	90	80	71	63	56	49	42	36		25	46	62	74	83	89	94	97		44
46	90	81	72	64	57	50	44	38		25	44	60	72	81	88	93	96		46
48	90	82	74	65	59	52	46	40	35	23	43	58	70	79	87	91	95		48
50	91	82	74	67	60	54	48	42	37	22	41	56	68	78	85	90	94	96	50
52	91	83	75	68	61	55	49	44	39	22	40	55	67	76	83	89	93	96	52
54	92	84	76	69	62	56	50	45	40	21	38	54	65	75	82	88	92	95	54

Original Circumference	Due to Combination of Internal and External Decay — Thickness of Solid Shell																		Original Circumference
	1			1½			2			3			4			5			
	Thickness of External Decay																		
	½	1	1½	½	1	1½	½	1	1½	½	1	1½	½	1	1½	½	1	1½	
24	49	33	20	59	38	22	63	40	22	65	40	22	65	40	22	65	40	22	24
26	49	34	22	60	41	25	65	43	26	68	44	26	68	44	26	68	44	26	26
28	48	35	23	60	42	27	66	46	28	70	47	29	70	47	29	70	47	29	28
30	47	35	25	59	43	29	66	48	31	71	50	32	72	50	32	72	50	32	30
32	46	35	26	58	44	31	66	48	33	72	52	35	73	52	35	73	52	35	32
34	45	35	26	58	44	33	66	49	36	73	53	38	75	54	38	75	54	38	34
36	44	34	26	56	44	33	65	50	37	73	55	40	76	56	40	76	56	40	36
38	42	34	27	55	44	34	64	50	38	74	56	41	77	58	42	77	58	42	38
40	41	34	27	54	44	35	63	51	40	74	57	44	77	60	45	78	60	45	40
42	40	33	27	53	44	35	62	51	40	73	59	45	78	61	47	79	62	47	42
44	39	33	27	52	43	35	62	51	41	73	59	47	78	62	49	80	63	49	44
46	38	32	27	51	43	35	61	50	41	73	59	47	79	63	50	81	64	50	46
48	37	31	26	50	42	35	60	50	41	73	59	48	78	63	51	81	65	52	48
50	36	31	26	48	41	35	58	50	42	72	60	50	78	65	53	81	67	54	50
52	35	30	26	48	41	35	57	49	41	71	60	50	78	65	53	82	67	55	52
54	34	30	26	47	41	34	57	49	41	71	60	50	78	66	54	82	68	55	54

Private Ownership Finds New Friends in M.O. Fight

Labor, business and surrounding communities successfully oppose plans for city's acquisition of Cleveland Electric Illuminating Company on assumption it will become an SEC orphan

ON JUNE 14, 1943, the City Council of Cleveland, Ohio, by a vote of 19 to 13, defeated a resolution stating:

> **That it is the intention of Council to acquire the properties and assets of the Cleveland Electric Illuminating Company in such manner and on such terms as shall be advantageous and in the best interests of the city of Cleveland.**

Among the "whereases" of the resolution were set forth the conditions that the Securities and Exchange Commission had ruled that the North American Company must dispose of the Cleveland property and that its acquisition by the city could be financed entirely by the issuance of revenue bonds.

The Kick-off

The specific agitation which resulted in the 19 to 13 vote was started April 20, 1942, when a councilman proposed an inquiry into the effect on Cleveland of the SEC order of April 14 divorcing C.E.I. from the holding company. In reply to this inquiry the city's special counsel reported on May 4 that the acquisition of C.E.I. by the city "under present conditions would mean a large annual saving to the consumers and taxpayers of the Cleveland metropolitan area." Immediately —in fact, the day after the report was presented—several bond houses indicated their interest in the prospective deal and the campaign of the municipal ownership advocates got under way. A quote from the May 6 column of F. F. Duncan, financial editor of the Cleveland *News*, says:

"Hungry bankers are in the get-ready stage for a $140,000,000 issue of Cleveland lighting revenue bonds . . .

"Avid municipal ownership fans are thumbing the company balance sheet and income account."

Newspapers Oppose

But opposition arose coincidentally. It manifested itself first in newspaper editorials and comment arguing that the recent acquisition of the traction system should be digested first before the city took a ten times bigger bite, that there still lingered various unpleasant aromas from the building of a new plant for the 40-year-old existing municipal power system, that the operation of certain other public service departments inspired no great confidence in the city's ability to handle a large electric system, that the C.E.I. service area—1,700 square miles extending 100 miles along the shore of Lake Erie and serving 350,000 customers in 132 communities—would impose too heavy a responsibility on the city. The three large Cleveland dailies, *Plain Dealer*, *Press* and *News*, printed about a dozen editorials opposing acquisition for these and other reasons in the period from the start of the agitation to the first hearing on the matter before the utilities committee of the Council on March 8 of this year. Newspapers of suburban communities also took their stand against the idea, apprehending loss of tax revenues, deterioration of service, etc. The Citizens League devoted the full content of the October 8 issue of its bulletin "Greater Cleveland" to a discussion of the affair, concluding that "There is no public demand or widespread desire on the part of taxpayers and voters for a change from private to public operation of this important utility. There seldom is when the private company is doing as outstanding a job as is the C.E.I. company." On February 11 the Mayor stated that he was not in favor of purchase of C.E.I. at this time.

It would be naive to say—or to imply by omitting such mention—that C.E.I. just sat back and took no part in what was going on. But it is the truth to say that the company did not engage in any extensive effort to influence public opinion. It published a few full-page advertisements, "Report of a War Industry," "Producing More Power for War Production," and the like, just as other electric utilities under no immediate threat of public ownership have done and are doing. Rather, the company depended on its judgment of the temper of the times and of local conditions and was content largely to leave its fate in the hands of its friends, many of whom intervened of their own volition. It is most significant that it did have friends who rallied to it, asked for information and were willing to go to bat for it, as will appear later in this story in the account of the public hearings on the resolution.

M. O.'s Rosy Promises

By official invitation on March 8, 1943, there appeared before the utilities committee of the City Council a representative of Otis & Company, Cyrus S. Eaton, one-time utility holding company magnate and for many years a colorful figure in the upper reaches of high finance. In brief, Mr. Eaton told the committee that in his opinion the city had a now-or-never opportunity to take over the power company and thus obtain a source of revenue from which large sums of money would flow into the city treasury every year. He figured that the property could be secured at a price

of $140,000,000, that this money could be obtained at a cost of no more than 3 percent by the sale of revenue bonds, that the bonds could be paid off in 30 years, and that the money retained by avoidance of taxes under municipal ownership, plus the amounts paid by C.E.I. in interest and dividends, would give the city of Cleveland an annual profit of something over $13,000,000.

The rosy picture painted by Mr. Eaton was somewhat marred by the sharply pointed questions of a couple of committee members who exhibited curiosity in regard to the use of depreciation accruals to pay off bonds and concerning the probable reluctance of other municipalities included in the C.E.I. system happily to accept loss of tax revenues in order that the city of Cleveland might profit at their expense. Also they seemed to feel that once it got bruited about that the city was swelling its utility revenue by avoidance of taxes there would be at least a slight resultant pressure for reduction of rates.

Editorial comment following Eaton's presentation was unfavorable:

> Somehow, a project whose main advantages come from cutting off federal revenue in the midst of war does not look so appealing today as it might have before December 7, 1941.—Cleveland *Press.*
>
> We think Mr. Eaton's appearance as a witness will strike the public as a little strange, and that his testimony can hardly be taken seriously until it is made clear that only public interest would profit by any such deal as he proposes.—Cleveland *News.*
>
> Here is a private enterprise that has served the community well in peace and in war. It has anticipated the public needs and has met them at reasonable cost and with excellent service. That the community would lose, rather than gain, from its sale to the city there is, we believe, no ground for reasonable doubt.—*Plain Dealer.*

Five Public Hearings

However, the M.O. bloc in the City Council took such strength from the optimistic picture painted with all the Eatonian skill in words and figures that it introduced in Council "an emergency resolution declaring the intention of Council to acquire the properties and assets of the Cleveland Electric Illuminating Company and to notify the Securities and Exchange Commission of such intent." This resolution—quoted at the opening of this story—was referred to the committee on public utilities, which found it necessary to hold no less than five public hearings, so numerous were those who wished to be heard, practically all in opposition.

The first hearing, March 25, was opened with a reading of the resolution, followed by a speech and presentation of a prepared statement by one of the proponent councilmen. From then on, through that hearing and the second, the opposition had the floor.

Surrounding Cities Oppose

First to be heard, and they were many, were officers of municipalities and other local governments included in the C.E.I. service territory outside of Cleveland. These witnesses were positive in their opposition, iterating and reiterating their objections. The points they made are stated comprehensively in a resolution adopted March 20 by the Cuyahoga County Mayors' Association by unanimous vote of the 30 mayors present at the meeting. This resolution urged the 59 municipalities and communities in Cuyahoga County, excluding Cleveland, to unite with the 72 other northeastern Ohio communities served by the C.E.I. "to oppose any such transaction by all means within their power."

As reported in the *Plain Dealer*, the mayors supported their contention with five points. These were:

> That under municipal ownership of the electric system by the city of Cleveland, other municipalities and communities would lose all rights which they now have under public regulation of electric service and electric rates.
>
> That under municipal ownership the 59 communities of Cuyahoga County outside Cleveland would suffer an aggregate loss of $700,000 a year in revenues which they now receive from taxes paid by the C.E.I.
>
> That under municipal ownership there would be no assurance of the continuity of adequate, dependable electric service at low rates which has been provided them by the C.E.I. for many years.
>
> That Eaton "based his financial representations on the results of operations of the Illuminating Company in 1942, which, because of wartime conditions, was the largest year in its history from the standpoints of power output, gross revenue and taxes" and that there was "no ground for believing that under municipal control and political operation in 1942 the results would have been the same." Therefore the association questioned Eaton's statement that the city would have made a profit of $13,054,435 if it had been operating the C.E.I. in 1942.
>
> That Eaton's elimination of $5,841,000 federal income taxes and $2,452,570 general taxes "if the city had owned the company" was a tax evasion scheme which particularly at this time is "unpatriotic and untenable," since the federal government "needs these funds to prosecute the war and the state and local governments require these revenues for use on the home front."

Labor's Voice

Many other voices than those from political subdivisions were heard in opposition. Labor had its say—the Cleveland Federation of Labor, the International Brotherhood of Electrical Workers, the International Union of Operating Engineers and the Teamsters District Council.

Local Union No. B-1336 of the International Brotherhood of Electrical Workers sent to all members of the Council resolutions opposing the proposition, which stated in part:

> The purchase of the company by the city would impair the rights of the employees of the company to organize for collective bargaining; it would introduce politics into a service that is basic and essential, and is best provided by an investor-owned company under public regulation; it would jeopardize the employment, wages and working conditions of most, if not all, of the company's employees; the policy of this union is to oppose municipal ownership, or any form of public ownership, of electric service systems, as antagonistic to labor.

Ralph Jamison, International Union of Operating Engineers, said his organization wanted to go on record in opposition because there are too many encroachments of government into the field of private enterprise and initiative is what America is builded on.

John Rohrich, vice-president, Teamsters' District Council No. 41, stated that labor's reasons for opposition to purchase of C.E.I. by the city is that the system is too extensive beyond the bounds of Cleveland and that government has already done too much against the good of all industry and labor in taking over business operations.

Thomas A. Lenehan, secretary, Cleveland Federation of Labor, said that the federation would go on record at its next meeting as being opposed to purchase of the C.E.I. He stated that in his memory of the past thirty years the company has had no difficulty with organized labor. (At a later hearing the C.F.L. action in opposition was put into the record.)

Business Goes to Bat

The most forceful voice speaking for business was that of Alfred E. Gibson, president of the Wellman Engineering Company, who compared business enterprise and government undertakings in terms of services ren-

dered, of operational efficiency, and of rewards to labor and management, and ended by saying: "We can governmentalize every industry in America, but gentlemen, if we do that, I don't know why in God's name we are fighting Germany."

E. L. Ostendorf, representing the Cleveland Real Estate Board, told how helpful the C.E.I. was in bringing new industries to the city. "It behooves us," he said, "to begin to work again in favor of private enterprise."

Parker Hill, vice-president Cleveland Chamber of Commerce, said the chamber "objects to the proposed plan for the city to embark upon such a grandiose scheme, deems it to be ill-advised and, from the point of view of Cleveland business, entirely objectionable. The chamber will oppose the plan to the extent of its available resources and influence."

Record of Good Service

Tom Dougherty, Dougherty Lumber Company: "Our superintendent is my authority that we have lost less than one hour of operation in twelve years because of power difficulties due to failure of C.E.I. equipment. . . . Among our customers are the Addressograph Corporation. Chase Brass and Diamond Alkali. . . . From their managements we learn that the sales, service and promotional efforts of the C.E.I. were of much importance in their reasons for being in their present locations. . . . We are fighting a great war against the ideology of national state socialism. It is ridiculous to sacrifice life and treasure if we embrace the philosophy of socialism at home."

These excerpts from the testimony of business men are typical of a great mass of the opposition registered at the hearings. They represent also the tenor of letters received from such concerns as Richman Brothers Company, large clothing manufacturers; National Acme Company, U. S. Truck Lines, Inc., White Motor Company, W. S. Tyler Company, Thompson Products Company, and from over a hundred more industrial and commercial establishments big and little, of all kinds and types. Also trade associations, professional groups and business organizations presented resolutions and memoranda in opposition. Included were the Apartment House Owners Association, Cleveland Advertising Club, Cleveland Engineering Society, Electrical Maintenance Engineers Association, Builders Exchange, Retail Merchants Boards, and many others.

Farmers Testify

The farmers had their say in the testimony of C. F. Christian, secretary of the Milk Producers Federation of Cleveland. He told how C.E.I. had been a leader in rural electrification. He questioned that a municipal utility in Cleveland would keep up that work.

Mrs. Norma Wulff, vice-president of the Cleveland School Board, speaking on behalf of the board, registered protest against the prospect of loss of school funds resulting from the cutting off of utility taxes.

The transcript of the hearings on the "resolution of intent" covers 349 typewritten pages, and of them at least 250 are taken by testimony in opposition. It is impossible to do more than indicate the flavor and content of these pages in a brief article like this. But enough has been shown to prove that the business and professional community of Cleveland and the citizens of outlying communities do not want the city of Cleveland to take over the C.E.I.

Proponents' Case

It is not the purpose of this article to present the arguments advanced in favor of acquisition of C.E.I. But it may be remarked that of the pages devoted to the proponents' case, nearly half were taken by a speech made by Paul Walter, president of the Cleveland Municipal Plant Association. There was one small detail of his speech worth noting. Speaking of promotional expenses of C.E.I., Mr. Walter asserted: "That type of propaganda would no longer be encouraged because the lower rates enabled by public ownership would make it unnecessary to promote the sale of electricity."

Another large occupier of the proponents' space in the record was Walter G. O'Donnell, not otherwise identified than as a former teacher in public utility regulation, who took 17 pages with a communication disclosing the familiar radical academic views on municipal ownership.

The final hearing, May 18, was closed with a controversy that at times verged on the acrimonious on whether or not Ohio law would allow Cleveland to take over the whole of the C.E.I. system. The point was not decided. Another previous argument had been on the exact meaning of the "resolution of intent." Did it mean that the city was obligated to buy the C.E.I. system if the resolution were passed, or was it merely to be taken as an expression of interest? If the first meaning were correct, would it bind the city in possible damages if the deal did not go through? This was not decided either.

Finally a motion was made that the public utility committee return an adverse report on the resolution. It was carried five to three. The vote would have been six to three had not one member, who later said he would have voted affirmatively, been absent.

The resolution had been referred also to the finance committee of the Council. This committee also reported adversely, by unanimous vote and without public hearings.

New Resolution Offered

The resolution came before the full Council on June 14 and after noting the adverse actions of the public utility and finance committees the Council voted 19 to 13 to reject the resolution. In a desperate attempt to save something from the wreckage the M.O. bloc hastily formulated and introduced another resolution. This was for the appointment of a special committee of seven members "whose purpose shall be to examine and study the feasibility and advisability of the acquisition and operation of the Cleveland Electric Illuminating Company and affiliated properties by the city of Cleveland and to report to the Council with recommendations thereon as soon as practicable."

It was moved that the new resolution be referred to the public utility and finance committees. The motion was carried, 15 ayes and 14 nays, some members of the Council having departed. The point was then raised that the resolution was legislative in nature, requiring a majority of the Council membership, not simply of members present, for passage. The law director ruled that this was the case and the resolution was declared defeated. Thus the extension of municipal ownership in Cleveland, if not dead, is at least moribund for a time.

Bunker Conveyor Control Relayed for Flexibility

Industrial type reverse-phase relay reverses reversal on carriage motor when belt motor is reversed from column station external to the trolley system

A. H. BEILER, Electrical Engineer, American Gas & Electrice Service Corporation

SOMETIMES a slight alteration in routine procedure can be the means of saving considerable expense on new construction work. Recently, enlargement of the coal-handling facilities in one of the central stations supplying the American Gas & Electric system required installation of a "shuttle" coal conveyor (Fig. 1) which moves along the coal bunkers and uniformly distributes the coal to them.

Such a shuttle generally requires two motors, one for motion of the belt carrying the coal and a second for propelling the carriage to the desired bunker position. Some shuttles use only one motor for the belt drive and obtain carriage motion by means of a clutch connected to the belt mechanism; others, although utilizing two motors, maintain a fixed relative direction of rotation of the two. Thus both motors may always rotate in either the same or opposite directions with respect to each other. Of course, both motors must be reversible, since a shuttle must move back and forth and the belt must reverse in order to serve all portions of the bunkers without extending beyond their confines.

Trolley Factor

Obviously, a three-wire trolley is required for three-phase motors; since such trolleys are not an unmixed blessing, it is desirable to limit their use as much as possible. Where the reversing controllers of both motors are on the shuttle, a single set of trolley wires will serve, since each controller is interposed between the trolley and its motor. Local conditions sometimes require belt control remote from the shuttle. Rarely would it be necessary to desire remote carriage control since a man generally rides with or walks alongside the slow-moving shuttle, so that the reversing control is almost always mounted on the shuttle itself.

On systems where shuttle and belt motors maintain a fixed relative direction of rotation, this again requires only one set of trolley wires. The reversing controller for the belt is connected between the main power supply and the trolley and a non-reversing controller for the carriage is connected between the trolley and the carriage motor. The direction of carriage motion is thus dependent on the direction of belt motion, the push button or other control on the shuttle serving only to start and stop the carriage motor. Various arrangements are indicated diagrammatically in Fig. 2.

To start the belt motor remotely,—the carriage motor at the shuttle and yet have independent control of direction of rotation of each—it would seem necessary to install two sets of three-phase trolley wires for this purpose. This is undesirable both because of expense and the increased maintenance problems.

A simple control scheme was devised whereby, whenever the belt motor was reversed external to the con-

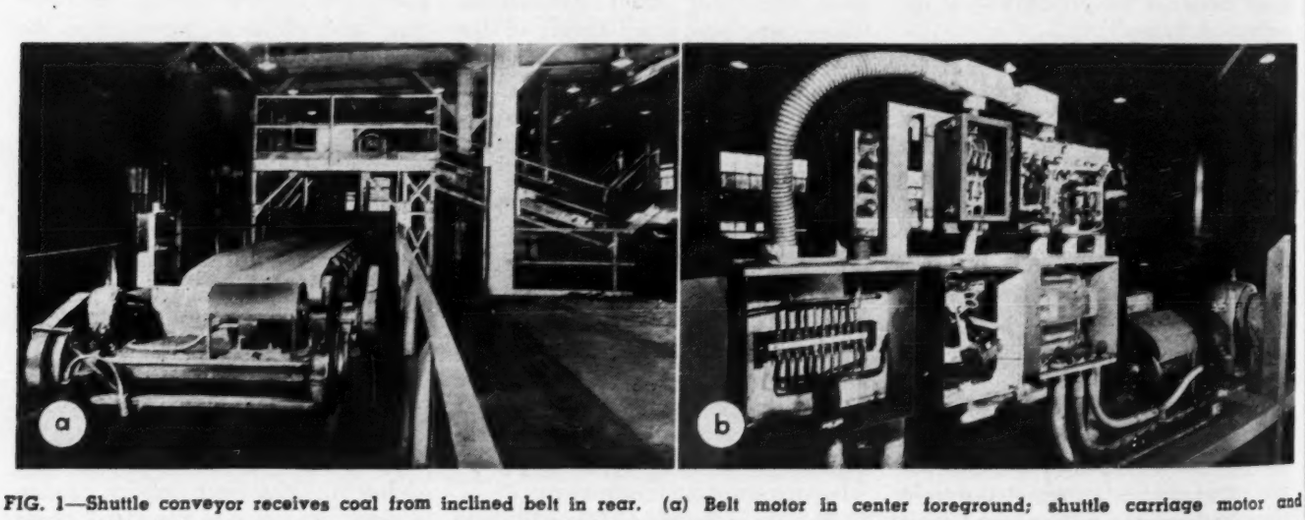


FIG. 1—Shuttle conveyor receives coal from inclined belt in rear. (a) Belt motor in center foreground; shuttle carriage motor and reducer at left; belt motor control on column at rear; carriage motor control on framework behind carriage motor. (b) Switch boxes on shuttle conveyor.

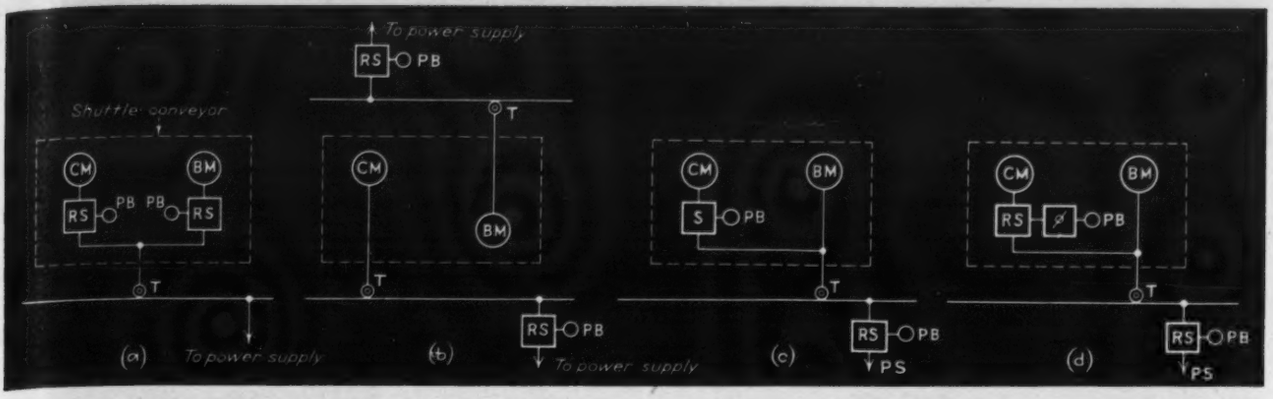


FIG. 2—Four possible schemes of control for independent reversal of carriage and belt with one three-phase trolley

(a) Both motors independently reversible, both starters on shuttle; (b) both motors independently reversible, both starters remote from shuttle; (c) both motors reversible (but with fixed relative rotation), belt starter remote, carriage starter on shuttle; (d) both motors independently reversible, belt starter remote, carriage starter on shuttle, automatic phase reversal. BM = belt motor, CM = carriage motor, PB = push button, S = non-reversing motor starter, PS = power supply, RS = reversing motor starter, T = trolley, Ø = reverse phase relay.

veyor, a reverse-phase relay reversed the reversal and maintained normal phase rotation for the carriage motor. Both motors were squirrel-cage machines, consequently both required only the standard forward-reverse magnetic switches for their control. An industrial control type of phase reversal relay and a small double-pole, double-throw auxiliary relay completed the required control equipment.

Local Circumstances

The reversing contactors for the belt motor, besides being subjected to manual control, had to be respectively energized in response to the position of a coal gate. Coal flow through one gate position required one direction of belt rotation; flow through the other position, the opposite rotation. The coal gate is on a stationary structure, receiving coal from the belt which dumps on to the shuttle, hence the belt contactors had to be on a stationary structure too, otherwise control trolley wires would have been required. These, then, were the local circumstances which necessitated a control scheme such as the one described.

Belt motor forward-reverse contactors are energized either manually by a hand-off-automatic selector switch used with a forward-off-reverse selector switch, or automatically by means of mushroom-head push buttons depressed by a lever operated by the coal gate. These contactors control the phase rotation in the trolley wires to which the belt motor is connected via the trolley.

Carriage motor reversing contactors take their power supply directly from the trolley. Coils of these contactors, called A and B instead of "forward and reverse" to avoid confusion, are controlled from forward-reverse push buttons so wired that either button may control either coil, this being determined by the position of the double-pole, double-throw auxiliary relay X, which in turn is energized or not according to the position of the phase reversal relay "ø." If phase rotation is such as to keep the contacts of ø open, X is deenergized and its normally closed contacts connect coils A and B to buttons F and R respectively. When the phase rotation is reversed by the belt contactors, ø closes its contacts, energizes X, which closes its normally open contacts and connects coils A and B to R and F respectively this time. Thus the forward button for the carriage motor always causes the same direction of carriage motor rotation, but it may close either of the two reversing con-

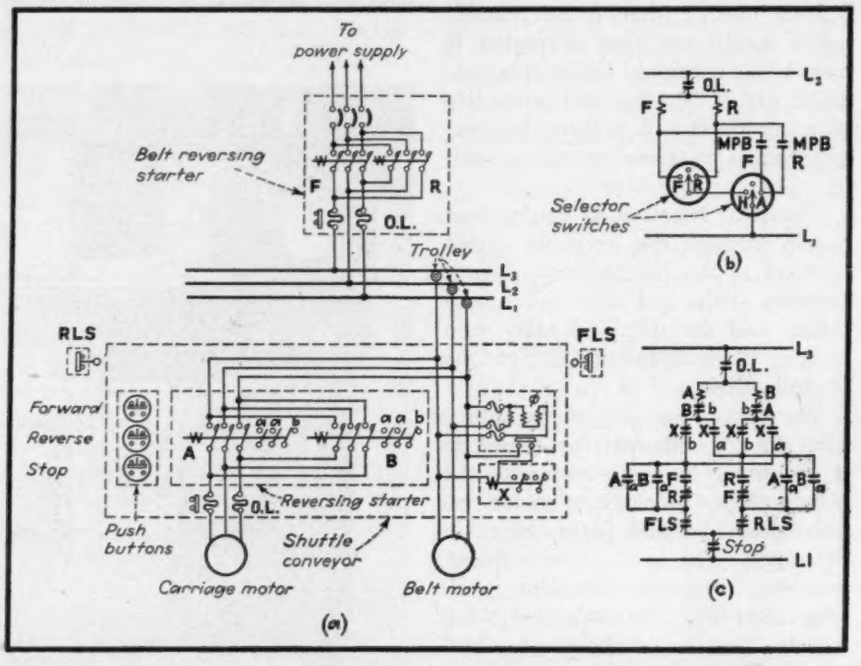


FIG. 3—Single-trolley suffices for independent reversal of belt and carriage motors (a) Starter and motor circuits. (b) Belt selector-switch control mounted remote from conveyor. (c) Carriage control mounted on conveyor. LS = limit switch, MPB = mushroom-head push button, OL = overload relay, X = auxiliary relay.

tactors to do so, and the same applies to the reverse button.

Since shuttle conveyors move slowly, it is frequently feasible to arrange the control so that the carriage motor runs only so long as its button is held in, as a man can walk along with the conveyor and inch it exactly to its required position. In this particular instance, however, the sealing-in type of control was desired whereby the momentary depression of a button operated the shuttle carriage motor. This required sealing-in contacts on both the A and B contactors to shunt around each push button.

Electrical Interlocks

Such an arrangement, however, provides a sneak circuit so that immediately when contactor A closed from, say, the F button, contactor B would tend to close via the normally closed contact of auxiliary relay X, and the auxiliary contact of A which shunts the R button. This was taken care of by normally closed auxiliary contacts on A and B inserted in the coil circuits of B and A respectively, insuring that once one of the coils was energized the other could not be. The mechanical interlock alone, usually furnished with reversing magnetic switches, would not have taken care of this. It is true that it would have prevented B from closing after A had closed, but it would not have prevented B from being energized under this condition and it does not add to the life of a contactor coil to keep it energized while its armature cannot pull in.

The usual interlock of the forward button through the normally closed contacts of the reverse button, limit switches at the end of travel, a stop button and the overload relay contacts in the coil circuit complete the control scheme.

Momentary opening of the trolley wire circuit (as when the coal gate is moved from one position to the other) stops the carriage motor, requiring that its push button be again depressed. This is no inconvenience, however, since the attendant is always close by. The important thing was to have an arrangement which would not confuse the operator by having the forward button move the carriage motor forward one time and backward another.

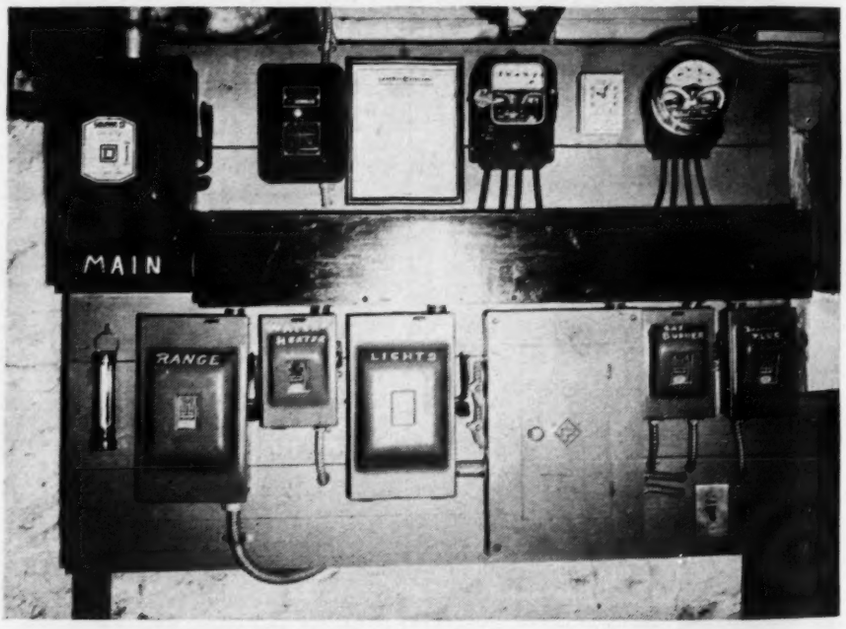
Water Heater Control Releases Peak Kw.

Ability of electricity system to carry war production loads increased by removing domestic water heating demands from the periods of daily peaks

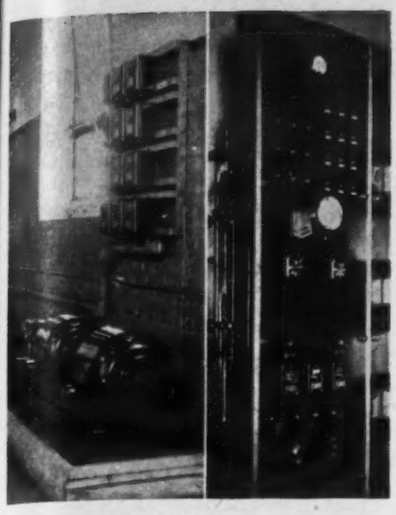
J. G. GLASSCO, Manager, City of Winnipeg Hydro-Electric System

PEAK CAPACITY now available for war production loads has been obtained at a cost of $26 per kilowatt on the city of Winnipeg Hydro-Electric System by changing domestic water heating from 24-hour to off-peak service. As soon as the war started and materials and equipments for new construction became difficult to secure it was seen that peak-load control of water heaters offered an immediate and desirable solution to the problem of capacity for war loads. The solution was desirable in that it required the minimum use of vital war materials and also allowed significant reduction in rates for water-heating service.

The system has 30,000 range and 23,000 water heater customers in the domestic service classification, saturations of 70 and 67 percent respectively. Range service is billed on the energy basis, one cent per kilowatt-hour, while the water heater charge is $3.33 per kilowatt per month for connected loads of one kilowatt or less, with lower unit charges for larger water heater sizes. Both range and water heater bills are allowed a 10 percent discount for prompt payment.



TYPICAL service-entrance installation; carrier-current controller for water heater at immediate right of main switch



HIGH-FREQUENCY (720-cycle) motor-generator in substation supplies water heater control energy (left); push-button control for motor-generator and selector switches for applying carrier current to 4,200-volt feeders are mounted on the same panel

It had been apparent for a long time that removal of the water heater load from the system peak would not only permit a lower rate for water heating, but would also compensate in terms of peak capacity release sufficiently to justify the capital cost and operating expense of the control system. Then, with the coming of the war, the peak capacity consideration gained much in weight and cogency and it was decided to make the change in water heater service forthwith.

Daily Cut-Off Period

Investigation of the load characteristics of the system showed that daily cut-offs not exceeding a total of two hours and 24 minutes (10 percent) would completely eliminate the water heater load from the system peak. As expected, the daily cut-off periods decided on by study of daily load curves coincide with the peak demands of the domestic range load:

11.35 a.m. to 12.14 p.m.....	39 min.
4.40 p.m. to 6.25 p.m.....	1 hr. 45 min.
	2 hr. 24 min.

Before deciding to go ahead with water heater control a 720-cycle high-frequency generator and a small number of controllers had been purchased and put on an accelerated life test for a period of twelve months. Special equipment was designed and installed for indicating operating failures. The results of the tests exceeded all expectations. On the other hand, it was kept in mind that freedom from trouble in accelerated life tests does not necessarily assure equally good results under normal operating conditions.

Customers' Alternatives

Then, as said, the decision was made to convert all water heater services on the system from 24-hour service to peak-load-controlled service. The first units were placed in operation in September, 1941, and by December, 1942, 6,517 controllers had been installed. The estimated reduction in system peak load from this number of controllers is 4,594 kw.

In making the change from 24-hour service to controlled service it was necessary to satisfy the customer that the change would be to his advantage. For this purpose the customer was offered the choice of the following alternatives:

(a) If the customer decides to continue to use the same capacity water heater with a 10 percent cut-off each day his flat rate charge is reduced 20 percent.

(b) If the customer decides to increase the capacity of his water heater to compensate for 10 percent less energy a 20 percent larger capacity water heater is installed for him free of cost and his flat rate charge is less than before. For instance, a customer changing from a 750-watt heater with 24-hour service to a 900-watt heater with 10 percent peak load cut-off each day receives 8 percent more energy and a reduction in his bill of 10 cents per month, as appears in the accompanying schedule of rates.

Water Heater Rates, City of Winnipeg Hydro-Electric System

Schedule E Flat-Water Heating

(Cost per Month)

Size of Water Heater	Rates for Uncontrolled Service	New Rates for Controlled Service
500 Watts...	$1.67	$1.33
600 Watts...		1.60
750 Watts...	2.50	2.00
900 Watts...		2.40
1,000 Watts...	3.33	2.67
1,200 Watts...		3.20
1,500 Watts...	4.44	3.56
2,000 Watts...	5.55	4.44
2,000 Watts...	2.22 per 1,000 watts	....

Contract Term — One Year.
Prompt Payment Discount — 10%.

COUPLING TRANSFORMERS for transfer of carrier signal to conductors of 4,200-volt feeder

Cost of the change, based on expenditures up to the end of 1942 for converting 6,517 water heater services, totals $118,130.72. Of this, $92,085.21 is for controllers and $15,994.51 for installing them. Necessary substation equipment makes up the remainder of $10,051. The unit cost per service thus figures to $18.12. There is an additional amount of cost which is a matter of the rate revision and is not directly a result of the effort to release peak capacity. This is the cost of replacing smaller with larger water heaters for those customers who elected that choice. Customers making that choice numbered 3,778 and the cost thus created amounted to $15,978.48 for water heaters and $6,621.13 for installing them, a unit cost per customer for increasing water heater capacity of $5.98.

Reduced System Peak

The number of customers, 6,517, changed from 24-hour to controlled service up to December 31, 1942, is considerably under one-third of all water heater customers. With the work of conversion less than a third done it is too early to arrive at definitive figures of peak capacity released and of cost thereof per kilowatt. However, preliminary calculation, using the costs to the end of the year, show that system peak has been reduced by more than 4,500 kw. at a unit cost of about $26.

PRIORITIES PROBLEMS

Capacitors for Conservation, Not Ratemaking

Case No. 74

Capacitors may get a considerable post-war play in the matter of improving the power factor of highly inductive loads and thereby effecting rate savings, but for the duration the use of capacitors will be allowed by OWU only where their use can effect a net saving in materials by allowing use of smaller conductor and transformers than would otherwise be required.

A utility applied to OWU for authorization to construct an extension to a manufacturing plant whose load was highly inductive. OWU approved the extension provided the company installed capacitors close to the load to reduce the size of the conductor and the transformers required to bring in service. The capacitors also removed the necessity for enlarging the transformer bank on the main feeder circuit.

In one coastal city capacitors saved many tons of copper when a large shipyard was put into production. The yard employed numerous arc welders, which gave the yard's load a low power factor. The load was of such consequence that larger transmission and distribution lines and transformers would have been required, so OWU ordered capacitors installed to save the utility from having to strengthen its lines.

In another industry 25-cycle capacity was tight and OWU was faced with the necessity of increasing generating capacity or losing manufacturing capacity. Choosing not to spend the required materials to increase 25-cycle generating capacity, OWU ordered the installation of capacitors to improve the power factor and carry the load.

When Is a Spare a Part of Inventory?

Case No. 75

Ever since the war curtailed the availability of materials to a point where the "gold plating" of utility service was discarded, the Office of War Utilities has been forced to keep an eye out for the practice of putting vital equipment or material in spare position and thus keeping it out of inventory. In many cases where sound engineering practice would call for at least one spare OWU has been forced to refuse any spare except that which may be available in the inventory of a neighboring utility.

A recent example of this is found in the case of a company which, to serve a military establishment, installed two submarine cables across a heavily traveled commercial waterway. At the request of the service it bought three cables, one to be kept on hand as a spare in case one of the two other cables was damaged so seriously as to halt service for more than a few hours.

The company managed to keep the spare cable in inventory without much trouble under P-46, but with the advent of U-1 and its tightened inventory restrictions the company found itself, in self-protection, forced to list the cable as excess inventory. To forestall the predicament against which the cable originally was bought, the company asked the service to buy the cable and hold it. The service sought permission to buy from OWU. Realizing that if the cable were sold to the service it would be removed from circulation permanently and would be available only for one possible use, OWU refused the service permission to buy and suggested that the company apply for authorization to exceed the inventory restrictions of Order U-1 on the wire, cable and busbar class by an amount equal to the dollar value of the cable. The company demurred, pleading that this would entail considerable extra bookkeeping, and asked that it be granted permission to exclude the cable from inventory. This process was unsatisfactory to OWU on the grounds that it, as in the case of a sale to the service, would tuck the cable away out of sight where its existence would be known only to the company and the service, thus removing it from circulation except for the one use to which the service would have put it had it been permitted to buy. The interchange was ended when OWU directed that the cable be kept in inventory and granted permission to exceed the restrictions of U-1 by the value of the cable.

Such a problem, of course, would arise only rarely, if ever, in the matter of the commoner types of inventory, such as transformers or popular sizes of conductor. In the case of these items, there would be sufficient quantities readily available to preclude any need for a spare. In the case of unusual and more or less custom-built equipment, however, there is a real problem.

OWU realized perfectly well that there was a definite possibility of damage to one of the two installed cables sufficiently serious to cause a prolonged outage. It realizes further that a prolonged outage would slow down or halt training activities at the military establishment. However, it realized that there is by no means enough copper or rubber available to allow appreciable amounts of it to lie idle awaiting an accident which,

UNTIL FURTHER NOTICE, all applications to purchase new power or distribution transformers of 1½ kva. or larger capacity must be made on form UF-23 (WPB-2643). The recommended procedure is to file all UF-23 forms with the nearest regional inventory control office even though the order may be for less than $100 for possible purchase from the excess stocks of another utility. Where the order is for a substantial quantity and the regional office thinks it can be filled from excess stocks, it will attempt to locate the needed material in other regions than its own if necessary. If the desired transformers are not "reasonably available," the regional office will forward the application to Washington for processing. When an order calls for transformers some of whose capacities are higher and some lower than 250 kva., separate applications should be used for those of lower capacity and for those of greater capacity. Separate applications should be used for each transformer of greater capacity than 250 kva., unless all units are identical.

with reasonable diligence, may never occur. It realized also that the one length of cable, which would have been bottled up for only one possible use had it been excluded from inventory or sold to the service, could serve as a spare for several local installations. Thus it ruled that the cable be kept in plain sight on the utility's inventory sheet where it could fulfill the functions which in peacetime would call for several cables.

"Single Form" and PD-1A Applications

Case No. 76

Some utilities misunderstand the use of form WPB-2774, the new "single form" recently inaugurated by the Office of War Utilities to simplify various applications. OWU's principal complaint is that some utilities are using WPB-2774 incorrectly to supersede PD-1A in all applications.

OWU emphasizes that WPB-2774 supersedes PD-1A only for utility construction or where a capital addition in excess of the $500 and $1,500 limitations of Order U-1 is involved. PD-1A must be used to obtain ratings for certain items of equipment, listed in Priorities Regulation No. 3, for which maintenance, repair and operating supply ratings may not be used. These items include photographic supplies, fire extinguishers, air raid precautionary devices and similar items. All PD-1A applications for items valued at less than $500 must be filed with WPB field offices.

An example of the misuse of WPB-2774 is found in the case of the company which attempted to use the AA-1 rating assigned by U-1 to MRO purchases for the purchase of fire extinguishers. Their order was refused by the supplier, who correctly considered the rating misapplied. Believing that WPB-2774 superseded PD-1A in all applications, the utility made application for a rating to purchase the fire extinguishers on WPB-2774. OWU had to return the application with the request that it be made on a PD-1A.

It was incorrect to use WPB-2774 in this case because the industry division which handles fire extinguishers is the agency which assigns the preference rating. Since no agency but OWU is authorized to issue a rating on an application on WPB-2774, the division handling extinguishers was powerless to issue a rating until it was applied for on a form it could process, namely, PD-1A.

DIRECTIVE NO. 8 to CMP REGULATION NO. 5, issued recently, provides that records of maintenance, repair and operating supplies may be kept on the basis of supplies received rather than amounts ordered in any quarter. CMP Regulation No. 5 provides that they are to be kept on the basis of orders placed rather than goods received. The relaxation of the regulation requires that a uniform system of accounting be employed throughout. Receipts may not be the basis for records of one type of material and orders for the rest. This directive formalizes the Office of War Utilities' long-standing practice with regard to orders P-46 and, subsequently, U-1. Practice has been to have the permanent record show materials actually received rather than those ordered in spite of the provisions of Paragraph (f)(1) which restricts the amounts which may be scheduled for delivery.

Correction

Case No. 70, ELECTRICAL WORLD, June 26, 1943, page 51, was incorrect in the total withdrawals from inventory which may be made by utilities which salvage usable material from plant. The case held that a utility which, having a $1,000 quarterly base for withdrawals in its transmission and distribution class under U-1, salvaged usable materials in this class totaling $1,250, could then withdraw $1,250 in that class during the quarter. Actually, such a utility could withdraw $2,250 worth of transmission and distribution material. This total includes the $1,000 of material the company could withdraw under any circumstances and the $1,250 salvage credit the company earned for itself. The Office of War Utilities emphasizes that to earn withdrawal credit the salvaged material must be usable, without repairs, as salvaged.

Any salvage credit in withdrawals must be taken in the same quarter as that in which it is earned. Where a utility fails to take full advantage in withdrawals of its salvage activity, it must account for the addition to inventory which the salvage represents in either of two ways. It can cut down correspondingly on replacement purchases designed to keep its PWM at its full allowable limit or it can classify as much of the salvaged material as excess inventory as is required to balance its books. Obviously, the purpose of the salvage credit provision of U-1 is to permit utilities to use material without permitting purchase for replacement.

An example was the case of a utility which had a $53,000 inventory in the transmission and distribution class, of which $40,000 was PWM and $13,000 was excess. During the second quarter the company withdrew the $10,000 worth of materials to which it was entitled. It also ordered and received during the quarter $5,000 worth of transmission and distribution materials to replace part of those it withdrew. During the quarter it also salvaged $6,500 worth of transmission and distribution equipment. The company chose, however, not to take any of its earned withdrawal credit, although it could have combined the $10,000 withdrawal base and the earned salvage credit for total withdrawals of $16,500. Thus it returned to PWM during the quarter $11,500, bringing its total transmission and distribution inventory to $54,400. Inasmuch as its PWM remained unchanged at $40,000, the company was required to list $14,500 as excess inventory, of which $1,500 was in salvaged material.

OWU feels that in those cases where a company does not take advantage of the extra withdrawals earned by salvage it should apply its salvage to replacing withdrawals. By doing this the company will stay out of the market for new equipment, thus saving materials, man and machine hours and transportation. Had the company mentioned above purchased only $3,500 worth of replacements for its quarterly withdrawals, that purchase would have balanced out with the $6,500 salvage credit at $10,000, the amount the company withdrew. Its excess inventory balance would have remained the same at $13,000 and $1,500 worth of new materials, man and machine hours and the necessary transportation would have been saved for other use in the war effort.

Editorials

S. B. WILLIAMS, *Editor*

The Pool Was Ready

HOW GOOD are power pools? The answer came less than a month ago when the Northeast power pool was put to about as severe a test as one would want. At 9 o'clock in the morning two 160,000-kw. units in New York City were lost—320,000 kw. in all—and the worst that happened was a short, small drop in frequency.

Power was pushed around pretty fast and in many ways, but the customers weren't inconvenienced. There was no waiting until somebody could get around to starting up a unit. The pool provided lots of sources and they all contributed according to their ability.

Of course, that is only one part of the functioning of a power pool. It's the spectacular part, while the daily, unnoticed but most important job is to keep energy flowing throughout an entire area in the most economical over-all manner. And in terms of war, that not only means the ability to handle emergency situations so as to prevent the loss of war plant operations but to conserve fuel and transportation while preserving and making firm, as much as possible, what would otherwise be undependable capacity.

Operations such as this not only assure the government and the public of better service continuity, as shown in the present instance, but are one of the things that help to preserve the continuity of the unbroken downward trend of rates by keeping the investment down through the pooling of capacity.

This isn't the only example of the war effectiveness of power pooling in emergencies. On more than one occasion the Southwest pool pulled the Arkansas aluminum plant out of trouble by taking care of the load dropped by the Ark-La line. This is the pool which, in spite of the fact that it has saved the government vast sums of money and production at the aluminum plant, is having such trouble with FPC in a renegotiation proceeding.

Two years ago power pooling saved the aluminum production in the Southeast when water was so low, and that experience was the basis for the regional integration provisions of L-94.

Power pools are, also, in some ways the greatest example we have in this industry of preparedness to meet most any situation. The men who are responsible for the successful operation of a pool know what is going on in the interconnected system at all times, and as soon as the slightest trend begins to show they know it and make ready. And that is why 320,000 kw. could be handled with hardly a flicker—the men knew where load could be transferred, when deliveries could be made or reversed. One of the first principles of a pool is to be ready whenever or wherever needed.

What Is an Electrical Engineer

WHAT is an electrical engineer? That question was asked of us recently, but as we progressed in our hunt for a definition we came to the conclusion it was one of those things that everybody understands but nobody knows.

One described an electrical engineer as one who uses electrical methods in carrying out engineering work, but since most definitions of engineering itself are so broad, this description is of little definitive use.

From the offices of A.I.E.E. we secured a definition of some fourteen or fifteen years standing which described an electrical engineer as "a person competent to plan and direct the economic production, transmission, distribution and utilization of electrical energy."

But that is only part of the story, for we can think of two important classes of electrical engineers that are not included—professors and research men. Moreover, the definition seems too confining.

So we ask the question, What is an electrical engineer? Is he the man that nobody knows?

Any one who is unable to go away this year for a vacation might find this question fully absorbing if time is hanging heavy on his hands.

Others Know How to Show Gratitude

UTILITIES and their employees have been honored for buying war bonds. They have been honored for excellence in metal scrap drives, and just recently they were honored on the West Coast by OCD for aid in the dimout. They have never been honored for the greatest job of all war material suppliers—never a shortage, never too little, never too late.

Some months ago when we suggested that the Office of War Utilities recognize the outstanding achievement of electric utilities with a Service "S" we got nowhere, on the flimsy excuse that it would be necessary to honor virtually all the companies because such a universally good job was done. Apparently that didn't deter OCD on the West Coast. In fact, we should imagine that the men in the fighting forces who are daily risking their lives

would be very happy if every concern in every war industry could be honored.

The employees in the power industry are just like those in every other industry. They listen to their bosses tell them how important their jobs are to the war effort and how necessary and patriotic it is to stay on the job. And then they see the fellows in the war factories get more money and get the Army-Navy "E" for working there. Did the power company get any recognition? And if it were such an important war job, why isn't it getting all the material it wants?

Nobody from Washington has taken any notice. Oh, yes, Mr. Krug did make a speech once down in TVA area, but, because of other news competition, even that wouldn't have received any notice if the power people had not spent a lot of money to give it publicity.

Nelson, Wilson and other important WPB people go out to visit steel mills and their employees, and they can't compare with the job the utilities are doing. But has Krug or Sickler or any other big shot in OWU ever visited with the employees of the power industry?

They probably have some appreciation of the job that has been done and some gratitude for the men and women of the industry, but you'd never know it. And when they give such flimsy excuses for not recognizing the achievements of these people with a Service "S" we begin to wonder whether they really mean it when they say that some way should be found to let the public know about these achievements.

The Army and the Navy know how to show gratitude and let the public know. So does the Maritime Commission, and the Scrap Drive and the War Bond Drive and now the OCD.

Do you remember that story of the little old lady saying with pride as her son was marching in the parade, "Everybody is out of step but Johnny"?

Please Be Patient

WE'RE SORRY. We know you are not receiving your copy of ELECTRICAL WORLD on time and, wherever the trouble is within our own walls, we're turning handsprings to correct it. But much of the difficulty is entirely beyond our control, especially transportation. We are using special expediters to co-operate with the Post Office and the railroads, but that has merely kept deliveries from being worse than they are.

It isn't only the shipping out of the magazines, but the shipping in of paper, the shipping of engravings and proofs—a delay in any one of which means a delay of the whole product. And when a magazine is not ready another one takes its place on the press, with the result that it must then wait until a press is free. In other words, delays in printing these days are pyramided.

It is terribly embarrassing to have to acknowledge these delays because we have always prided ourselves in "coming out" on time, regardless. We will still do everything possible to try to improve conditions, but in the meantime we ask you to remember that both the railroads and the Post Office have had a tremendous load placed on them and are doing extraordinary jobs. We'll all do our best—please be patient with us.

Cleveland Plans for the Future

WHEN the Cleveland City Council voted against the purchase of the Cleveland Electric Illuminating Company last month it did more than just turn down an extension of municipal ownership. What it did was to give Cleveland business and Cleveland labor the assurance that, so far as that city was concerned, private ownership and operation of business need not fear for the future so long as it was contributing to the public welfare.

This will perhaps have greater significance when it is pointed out that the big fight for preservation of private operation was not made by the power company, but by the surrounding communities and by business.

Cleveland has ambitions. It wants to be the best post-war city in all the world. It has a program which the Mayor launched the first of this month. But how could Cleveland become the best post-war city if the mainspring in bringing new enterprises to the area, if the most active agency in improving labor's productivity by increasing the power at its disposal, were to be replaced by a political agency?

The electric utility company probably has the greatest stake of all in the community it serves. It is to its advantage to keep the whole area happy and at work. For any city to destroy this particular initiative at this time is nothing short of stupidity. The post-war prosperity of nine out of every ten communities begins with the hopes and ambitions the power company has for its future. That is why so many local post-war planning councils—C.E.D. or otherwise—are headed up by utility men or have utility fellows doing important committee work. Where would most of these councils be if it were not for the utility man?

If a power company were convinced that it had no future, that its earnings would never be permitted to improve or that the city would swallow it before very long, what incentive would it have to expand or to bring new concerns to its area? Why should it lift a hand to help the area?

Business in Cleveland saw in the threatened city purchase of the Illuminating Company not only a threat to private ownership but also that much more tangible thing, the threat to the city's competition with other cities, the threat to industrial progress. And that was really why the private operation was permitted to continue in Cleveland, and that is why it should be permitted to continue in every city of the land that has any desire to expand and to keep its community economically healthy.

Washington Comment

R. N. LARKIN, *Washington Correspondent*

Disposition of Excess Inventories

ARE electric utilities going to sit out the war with considerable stocks of such critical materials as steel and copper idle in surplus inventory?

Will utilities, or other companies using the same equipment, go into the open market for materials and man-hours to make new equipment while the same items lie idle somewhere in excess inventory?

Will the utilities be forced to rid themselves of considerable quantities of idle metal and in doing so sustain the loss which must follow when usable equipment is scrapped for its metal content?

These questions, and several others more or less intimately related to them, are forcing themselves into the thinking of the Office of War Utilities control inventory branch. The thinking thus far tends along lines which, followed rigorously, would cost the utilities some money.

No Program of Compulsion

It must be understood that OWU's inventory control people are not bureaucrats intent on gouging private enterprise for the satisfaction of so doing. There is no program of compulsion in effect or in preparation which aims to drive onto the scrap pile every item of equipment which gives little prospect of being usable during the war, leaving the utilities meanwhile to write off as loss the difference between what they paid for the equipment and what it sells for as scrap.

Electric utilities have on hand today considerable inventory which is classified as surplus under the terms of Order U-1. Much of this inventory consists of copper and steel, two of the most critical metals. It is inconceivable that the industry should want, or be allowed, to go into the open market to drain from existing supplies material with which to make equipment which already exists and lies idle in inventory. Finally, with steel and copper as short in supply as they are, it is also inconceivable that a surplus inventory containing appreciable quantities of these metals should be allowed to stand idle through the war period.

No quarrel is raised with the practice of holding idle in excess inventory equipment for which a need can be seen. To scrap such material would merely be to waste man and machine time and to hasten the day when the industry would have to go into the open market to replace it.

Idle Stocks Are Moving

The inventory redistribution program established by OWU last winter has been and is moving idle stocks. However, there are some items of excess, common to most utilities and containing large quantities of copper and steel, for which the demand has been limited. It has become apparent that unless some way is found to make the redistribution program affect these items, the answer to the first question will be, "to some degree, yes."

The answer to the second question will be the same unless the utilities establish a practice of putting the older and less attractive equipment into practical working minimum inventory and segregating better material in excess, whence it is eligible to be siphoned off by other users.

OWU suggests that only that material be put into excess inventory which the owner would be content to use on his own system. This would leave considerable old, relatively poor equipment in practical working minimum inventory. That part of it which owners would not consider using on their own systems should then be scrapped and made available for more valuable use in the war effort, OWU feels. If financial loss results, it will be cushioned to a large degree by the savings on excess profits taxes, and valuable war materials will have been made available.

There is not as yet any clear-cut answer to the third question. OWU has no confiscatory program in the making. It is charged, however, with making the best possible use of these critical materials in the war effort. The job is being done in the interests of the electric utility industry by the war agency established to guide the industry. The people who make the decisions are people with industry experience, who know the industry's problems. It would seem to be to the industry's benefit to help these people do such a good job that there will be no concerted attempt to transfer the job to another agency with less knowledge of and regard for the needs and problems of the electric utility industry.

Uses Outside the Industry

OWU is making certain progress toward disposition of those excesses which it feels probably will not be used up by utilities during wartime. It is trying, for instance, to have the Army and other agencies which are buying weatherproof wire from wire mills buy as much as they can from utility excess. It has been developing a program whereby many meters which appeared frozen for the duration in excess inventory will be sold to Latin-American customers who have been trying to buy new meters from manufacturers. It has been urging non-utility users of underground cable to fill their needs from utility inventory. It is pondering a program which would call for the scrapping of older cable and the replacement of such cable with new cable from excess stocks. This would cut the financial loss which utilities would face in scrapping new cable.

It is attempting also to sell to the Army Signal Corps some of the large utility supply of excess pole line hardware. One of the more satisfactory programs has been to refuse priorities for high-tension transmission lines unless the owner agrees to get his conductors from excess stocks by purchasing idle supplies of bare copper conductor and paying the premium for reworking it into the necessary size.

NEWS OF THE WEEK

Power Conservation Program Agreed Upon

"Early September" set as start of drive, sponsored by OWU, to save fuel, transportation, manpower and critical materials — General lighting specifications adopted summarized herewith

"Early September" has been set as the goal for the opening of the broad conservation program sponsored by WPB (ELECTRICAL WORLD, July 10, 1943, page 67) as a means of saving fuel, transportation, manpower and other critical resources.

The specific program drawn up by the Office of War Utilities task committee July 13 was adopted by the informal industry advisory committee with the statement:

"The committee believes that this voluntary program will enlist effective public support and will thereby achieve substantial results. It urges its adoption."

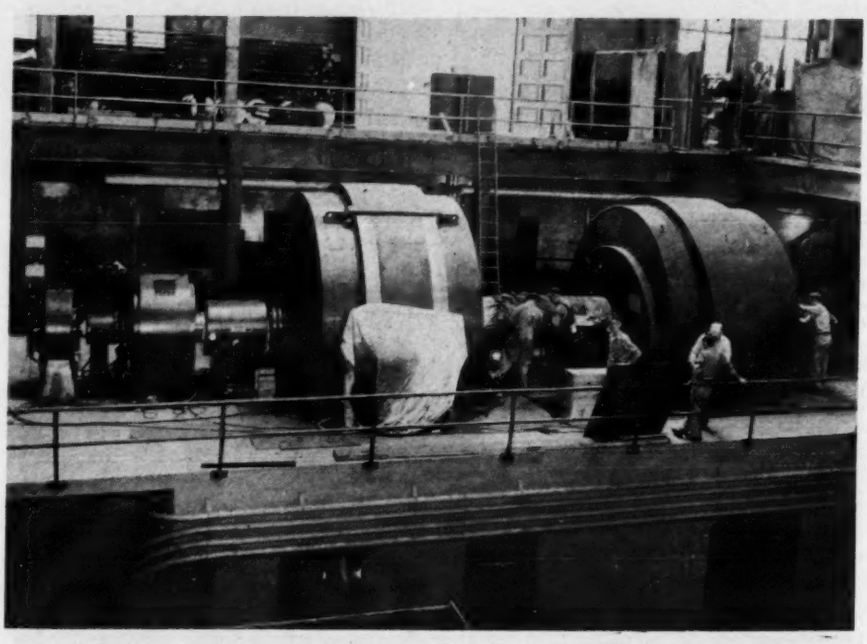
Utilities to Promote

Announcement of the utilities' part in the broad program was accompanied by a letter from OWU Director J. A. Krug. Utilities will be asked to disseminate the program to local agencies and groups, to their employees and customers by media recommended in the program. Concurrently, OWU will circularize national and trade associations, civic and other national groups to enlist their co-operation. A suggested statement drawn up by the task committee emphasized that the conservation was to affect "manpower, transportation, fuel, equipment, and critical material such as copper, steel, tungsten and many others. . . ." It emphasized that "installed generating capacity, together with capacity now under construction, is ample to meet all foreseeable electric needs. But it is essential to save the use of electricity wherever possible so as to reduce, directly or indirectly, the demands for materials, fuel, transportation and manpower."

Burden of establishing and maintaining the program falls upon local utilities. WPB will co-ordinate their efforts, as well as those of the other industries in which the over-all program will be carried on through an inter-industry committee.

Trade organizations and other agencies in the electric power field which will be called upon to assist in the utility campaign include the American Public Power Association, Council of Electric Operating Companies, Department of the Interior, Edison Electric Institute, National Rural Electric Cooperative Association, Rural Electrification Administration and Tennessee Valley Authority. Intra-industry coordination will be carried out by the main committee assisted by such task committees as may be appointed to handle specific questions.

National and state-wide trade organizations will be enlisted to help on the consumer end of the program. Such groups will be asked, whenever necessary, to support or assist in specific



BOOSTS 60-CYCLE CAPACITY—This 12,500-kw., 25 to 60-cycle frequency changer, which will go into service at Kansas City's Grand Avenue station some time in July, will increase the company's 60-cycle capacity by 12,500 kw.

programs which may be necessary or desirable.

Other agencies whose support has been enlisted include the Federal Power Commission, National Association of Railroad and Utilities Commissioners, state regulatory commissions and the United States Conference of Mayors, as well as similar organizations.

Lighting standards prescribed by the task and industry advisory committees are more general than detailed. Local utilities will be asked to "sell" them to customers through their sales and technical personnel. It is anticipated that public opinion will be a large factor in eliminating the non-essential uses at which the whole program is aimed.

Both committees agreed that local situations may require some slight deviation from the program in media and method, but both emphasized that no significant deviation should be practiced until it has been approved by WPB as affecting the entire program and all participating companies.

Specifications

The committee aimed its curtailment specifications at four types of lighting, commercial, residential, industrial and white-way street lighting as follows:

Indoor and outdoor advertising, promotional and display sign lighting—Eliminate all daytime lighting. Reduce night burning hours as far as possible, in no case to exceed two hours of lighting between dusk and 10 p.m., local time. Signs necessary to direct the public and identify public places should not be operated except when the establishment is open for business. Lamp wattage should be reduced.

Decorative and ornamental lighting, including decorative floodlighting—Eliminate exterior lighting completely at all times. Eliminate all non-essential lighting and reduce the balance as much as possible.

Show-window lighting which does not provide essential interior illumination—Eliminate daytime lighting completely. Reduce night burning hours as much as possible, not to exceed two hours between dusk and 10 p.m. Reduce wattage.

Lighting of marquees and building entrances (other than advertising signs)—Eliminate daytime lighting completely. Reduce night time intensity as much as is consistent with public safety. Eliminate completely when establishment is not open except the amount necessary for protection.

Lighting of outdoor business establishments—Eliminate daytime lighting completely. Reduce night intensity as much as possible. Eliminate completely when not open for business except that necessary for protection.

General interior illumination and showcase lighting—Eliminate all nonessential lighting. Reduce remainder as much as possible consistent with public safety and eyesight conservation.

General conservation by commercial customers—Turn off lights and appliances when not actually needed. Eliminate all unnecessary use.

Air conditioning—Adopt more moderate margins of reduction in temperature and relative humidity.

White-way street lighting—Reduce wherever practicable to lower levels consistent with public safety.

Residential—Eliminate all waste in use of appliances. Turn off lights and appliances when not actually needed.

Industrial—Utilities should suggest possible economies to industrial users, keeping in mind the necessity of maintaining or improving production.

No effort should be made to curtail necessary military, aviation and police lighting, lighting essential to public health, including eyesight, safety, plant protection, transportation and production lighting. Outdoor recreational activities are not affected on the basis of morale maintenance.

Media through which the program is to be sold include national and local newspaper and magazine advertising, radio, displays in offices, posters, truck cards, addresses before local groups and clubs, bill stuffers, personal contacts with municipal authorities, contact with customers by utility employees, education of employees and possible mat services.

OWU was asked to prescribe a reporting procedure to be used by all participating utilities. It should arrange for collection of data and prepare such regional or national statistics as may be required.

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May Revenues Up 7.9 Percent

Electric operating revenues of the larger privately owned electric utilities in the United States in May, 1943, were $235,660,000, as compared to $218,431,000 in May, 1942, an increase of 7.9 percent, according to a report by the Federal Power Commission.

Revenues from sales to ultimate consumers were up 8.5 percent to $213,365,000 and electric operating revenue deductions (including operating expenses, depreciation and taxes) were $182,290,000, or 8.4 percent over those of May, 1942.

Net electric operating revenues increased 6.3 percent to $53,370,000, and gross income, including other utility operating income, increased 8.6 percent to $64,400,000. Income deductions decreased 0.8 percent to $25,593,000. Net income in May, 1943, was $38,807,000, an increase of 15.8 percent over the net for May, 1942.

Revenues by classes of service in May, 1943, compared with the same month of 1942 were as follows: Industrial, an increase of 15.3 percent; residential, an increase of 5.8 percent; commercial, a decrease of 0.1 percent. Operating expenses in May, 1943, were $102,085,000, or 7.3 percent greater than those of the same month last year. Depreciation charges were increased 4.8 percent to $24,317,000 and taxes increased 11.4 percent to $55,258,000.

NEWS BRIEFS

NEW YORK'S PUBLIC SERVICE COMMISSION has authorized the New York State Electric & Gas Corp. to put into effect July 27 a system of bi-monthly meter-reading and billing in certain sections of the company's territory.

THE CAPITOL was without air conditioning recently as the result of a gas explosion which damaged six motors driving air compressors for the refrigerating system. No cause was given for the blast, which rocked the neighborhood immediately south of the Capitol, but did not damage the main power plant for the government buildings in that area. Electric service was out temporarily, but restored with auxiliary generators.

GRANDPA'S KNOB, pioneer large-scale wind-power-generating unit near Rutland, Vt., has produced about 300,000 kw.-hr. thus far in its developmental period. The installation has a normal rating of 1,000 kw. and delivers energy to the Central Vermont Hydroelectric Co. system from its location in the Green Mountains. While a number of problems of mechanical importance continue to occupy the attention of those responsible for the development, encouraging progress is being made toward the establishment of routine operation.

I. B. JORALEUM, Defense Plant Corporation engineer from the San Francisco office, met recently with a group of consulting engineers in Portland, Ore., preparatory to starting a survey of aluminum clay deposits in the Portland area. This is in connection with his recommendation to WPB for a $4,000,000 plant to be the first of consequence to process alumina from native clays, instead of using bauxite ore from Arkansas or Dutch Guiana. The alumina is needed for the reduction plants of Oregon and Washington. The 5,000 kw. of power needed would come from the Pacific Northwest pool.

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Hatfield to Handle Production Scheduling

Robert M. Hatfield, formerly chief of the Boilers and Auxiliaries section of the Office of War Utilities' Power Division, has been appointed acting director of WPB's Production Scheduling Division.

Hatfield came to WPB in January, 1942, from Combustion Engineering Company, Inc., for which he was a sales engineer in Cleveland.

500,000 Kw. New Capacity in 1945 Power Program

Smallest "war program," announced by Office of War Utilities, includes seventh 108,000-kw. generator for Grand Coulee, 80-120,000 kw. new hydro capacity for existing TVA dams

The Office of War Utilities' 1945 power program, announced this week, calls for installation of approximately 500,000 kw. of generating capacity which will be divided about equally between public and private stations.

Largest item in this smallest "war program" is a seventh 108,000-kw. generator for Grand Coulee, one of the Reclamation Bureau projects which was downrated last summer. Another 80,000 to 120,000 kw. of hydro capacity will be installed in existing TVA dams.

Specific Units Authorized

In addition, the program calls for:

1. A 20,000-kw. steam unit for the San Antonio, Tex., municipal system to come in late in 1944.
2. An additional boiler for the Jacksonville, Fla., municipal system to add 15,000 kw. late in 1944.
3. A 20,000-kw. steam unit for the Evansville plant of the Southern Indiana Gas & Electric Co., for late 1944.
4. A 20,000-kw. steam plant to be built at Pensacola, Fla., by the Gulf Power Co., to come in early in 1945.
5. A 25,000-kw. steam unit for the St. Petersburg plant of the Florida Power Co., to come in early in 1945.
6. From 150,000 to 200,000 kw. of steam units for private stations in the central industrial area of Illinois, Indiana, Ohio, western New York and Pennsylvania and West Virginia.

The small installations along the Gulf Coast and in Evansville are to alleviate local tight spots which could be handled in this fashion with less critical materials than would have been required to construct lines to surplus areas, OWU explained.

The large block of hydro capacity is a reflection of the general policy that where there is an otherwise even choice between steam and hydro, the latter must win out because of anticipated difficulties in supplying fuel, an OWU official declared.

TVA's Share

Final decisions on the TVA and central industrial area programs have not yet been made. Size and location of TVA units will be determined within two weeks. It is expected that three or four units of approximately 30,000 kw. will be installed. One almost certainly will go into Kentucky Dam, near the confluence of the Tennessee and Ohio rivers, where all imbedded parts for a 32,000-kw. machine are already in place and where the demand exists for 100 percent load factor power from at least one more machine. A second unit may be installed at Kentucky, and Chickamauga, Fort Loudon and Guntersville dams are other likely locations. These units will be placed where they will best mesh into already heavily burdened transmission systems with the least use of materials and where they will operate at the highest possible load factor.

If as many as 200,000 kw. of private units are approved beyond these at Evansville, St. Petersburg and Pensacola, a few units will be located outside the central industrial area to relieve other local tight spots. This program will not be determined in detail for about another month inasmuch as the units can be scheduled for 1945 delivery at that time.

Minimum of Surplus

The new program will leave the country with about the minimum of surplus generating capacity that it can afford, OWU Director J. A. Krug declared. It will bring the war power program, computed from just before Pearl Harbor, up to 8,000,000 kw., well under the 20,000,000-kw., program espoused until a few months ago by the Federal Power Commission. For the duration, Krug asserted, new construction can probably be held to isolated areas.

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30,000-Kw. Station of A. P. & L. Dedicated

The Arkansas Power & Light Co.'s new $3,000,000 steam-electric generating plant, named the Harvey Couch, in honor of the late founder and longtime president of the company, was dedicated on July 16 with fitting ceremonies. The plant, a 30,000-kw. outdoor type station, is located on the edge of the "sour gas" fields of south Arkansas. It will use gas which has been desulphurized. It is the first

NEW FLUORESCENT JOB—Nearly a quarter of a mile of fluorescent lamps—1,200 feet in all—provide virtually shadowless illumination approximating 60 foot-candles at working levels in this new engineering and drafting department at the Westinghouse plant in Emeryville, Cal. The installation uses 300 40-watt lamps, alternately daylight and white, in continuous strips. Rows are 3½ feet apart, mounting height 11 ft.

Arkansas industry to use the gas, which has been going to waste for two years.

Actual operation of the plant is scheduled to start this month. A 17-mile, 110-kv. line has been completed to transmit power from the plant to the A. P. & L. system, which is interconnected with the systems of Louisiana Power & Light Co., Mississippi Power & Light Co. and New Orleans Public Service, Inc., all companies developed by the late Mr. Couch and associates. The plant also is tied into the Southwest power pool.

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Sees War Contract Payment Law Passed

Legislation promised to speed settlement of claims

The Senate's small business committee will get legislation to provide prompt and liberal payment in advance of final settlement of terminated war contracts when Congress returns to the Capitol next fall.

Murray's Plan

Chairman James E. Murray, Montana Democrat, promised to present the legislation, declaring the subject to be "one of the prime tasks before the present session of Congress." Legislation offered thus far, he asserted, fails to provide a satisfactory approach to the problem in that it merely authorizes procurement agencies to make such settlements and does not require them to do so. Nor does it authorize payments directly to subcontractors, Murray complained. Widespread insolvency, unemployment and handicaps to reconversion are the results of failure to make prompt settlement and advance payments on terminated contracts, Murray said.

Murray's six-point plan would:

1. Make payments to contractors and subcontractors mandatory in advance of settlement.
2. Allow advance payments of at least 75 percent of the amount certified by the contractor or subcontractors.
3. Require advance payments within 30 days after certification.
4. Allow procurement agencies to make or guarantee loans against terminated contracts through private banks.
5. Allow the contractor or subcontractor to sue the government if he does not receive at least the minimum amount within the stipulated period.
6. Require establishment of uniform contract termination policies by the chairman of WPB.

Grant Rate Raise Right on Co-op Power Resale

Arkansas commission, in important decision, recognizes right of privately managed utilities to charge standard wholesale-for-resale rates to co-ops which expand to municipal operations

Arkansas Department of Public Utilities, in a decision expected to have far-reaching effect, has recognized the right of business-managed power companies to charge standard wholesale-for-resale rates to rural electric cooperatives which attempt to expand from strictly farm to municipal operations. (ELECTRICAL WORLD, June 12, page 86).

The decision was issued after hearing on an application by Oklahoma Gas & Electric Co. to put into effect an availability clause in its contract with rural co-ops whereby its standard wholesale-for-resale rates shall be charged if the co-op sells to towns of more than 250 population or to industries requiring more than 30 kva. of capacity.

Deny A. P. & L. Application

Arkansas Power & Light Co. filed a similar application, but the company's application was general in nature and did not ask that towns of any certain population or industries of any certain capacity be used. It merely asked that the standard wholesale-for-retail rate be made applicable when a co-op served any but a strictly rural customer who had not heretofore been receiving central station service. The power company contended this classification was set up for rural customers in the REA Act.

Ironically enough, the Arkansas Valley Electric Co. of Ozark, which the Oklahoma Gas & Electric Co. serves, does not yet have any municipalities in its system, whereas several co-ops served by Arkansas Power & Light already are supplying towns, using power bought wholesale from A.P.&L.

In its application Arkansas Power & Light asked that it be permitted to apply the standard wholesale rates to the co-ops reselling to towns, because if this was not done discrimination would result, since the company already sells north Little Rock on the standard wholesale-for-resale rate.

Arkansas Power & Light's application was denied on this technicality by Arkansas Department of Public Utilities, which agreed A.P.&L. could file specific application such as O.G. &E. and get approval.

The department denied A.P.&L. had proved discrimination. "Before a rate can be discriminatory it must not only create a preference in favor of the customer, but also must result in injury to the other customer of the same class, by reason of the preference to the first customer," the department's order said.

In granting the standard rate for wholesale of power to co-ops, the department several years ago ordered the A.P.&L. rate to be discounted 50 percent. "It does not appear that the discount made available to rural cooperatives for retailing to any of their customers resulted in injury to other customers of the applicant company," the department held.

The department said it did not mean to hold that a different rate for different classes of service in co-operative territory might not be made, but ruled that "it is not within the jurisdiction of this department in this case to prescribe such a rate."

REA Enters Hearing

The Rural Electrification Administration itself entered into the hearing to protest the granting of the availability clause effectiveness on the grounds that it would set a precedent for other states which might prove disastrous to co-ops all over the country if similar applications were granted. REA officials testified, as did officials of Arkansas co-operatives, that it is almost essential for co-ops to have communities with concentrated customers if they are ever to pay out their loans.

Both O.G.&E. and A.P.&L. made it clear at the hearing that they were not protesting against the discount to customers strictly in the class of rural, but did protest having to sell co-ops power at wholesale to be resold in communities which have systems already developed.

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Approve Utility Purchase

At a recent election citizens of Thatcher, Ariz., approved issuance of $465,000 revenue bonds for purchase of local electric system of the Arizona General Utilities Co., a subsidiary of the Associated Electric Co.

Denies OPA Authority on Rate Decrease Petition

Wisconsin Public Service Commission dismisses agency's plea in Milwaukee Gas Light Co. case on grounds that Congress conferred no authority on OPA to determine utility rates

Ruling that the OPA has no congressional authority to interest itself in a proceeding to determine whether rates of a utility should be decreased, the Public Service Commission of Wisconsin recently dismissed an OPA petition opposing the application by the Milwaukee Gas Light Co. of its automatic fuel adjustment clause, based on the cost of competing fuel.

Inflationary Claim Unproved

The case resulted from the application of the company's fuel clause which adjusted space heating charges from 43 cents per MCF to 45 cents for gas furnished in excess of 10,000 cu.ft., in compliance with its filed and approved schedule of rates in 1935.

In rejecting the OPA application, the Wisconsin Commission ruled that contrary to the OPA contentions: (1) the adjustment clause is now and has been at all times a part of the company's lawfully filed rate structure; (2) that OPA claimed but did not prove the adjustment from 43 to 45 cents was inflationary, and (3) that the new charge will not afford the company an excessive rate of return.

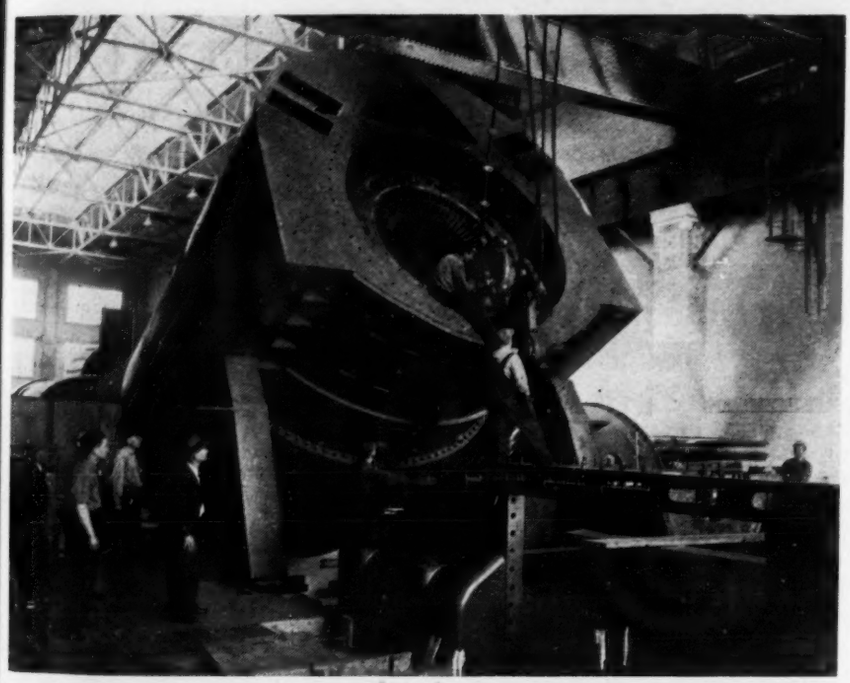
Consistent with the commission's decision in a telephone rate case decided May 5, 1942, freezing utility rates unless it would be necessary to protect the financial stability of a company, the commission, coincidentally with the dismissal of the OPA petition, ordered an investigation of rate schedules of all gas companies which contained adjustment clauses based only on competitive prices.

Extracts from the commission's far-reaching decision are as follows:

"It is our understanding from the plain language of the Emergency Price Control Act of October 2, 1942, that the petitioner has been given no authority to petition for, or interest itself in, a proceeding the purpose of which is to determine whether rates of a utility should be decreased. We are convinced that the absence of that authority conveys the congressional intent to leave those matters with the permanently established and now functioning regulatory agencies.

"We do not, however, at this time pass upon the question as to whether this is an application for a decrease in rates, and because of our disposition of this case, as hereinafter set forth, it will be unnecessary for us to rule on the motion. We will say, however, in passing that it is our considered judgment that it would be contrary to Wisconsin law for the company to make charges other than at rates which are authorized and prescribed by this commission. . . .

"Without question, the present charge of 45 cents per MCF is in accordance with the company's filed rate schedule and is presumptively both lawful and reasonable. We think it highly significant to reiterate that the adjustment in rates results not from an immediate affirmative act of the company whereby it seeks to add to its income by raising rates, but rather by the faithful application of its rates as lawfully filed and approved eight years ago. While it may be asserted that the mere increase of any price is inflationary, it is noteworthy that the proximate cause of the adjustment here under consideration is the increase in the price of No. 3 fuel oil made on December 29, 1942, either with the consent or approval of the Office of Price Administration, and that such increase of 3 cents per gallon will add millions of dollars to the nation's fuel bill. Thus, it must be concluded that other considerations may outweigh the potential inflation involved in price increases. The mere fact alone that the price of space-heating gas has been increased is not sufficient to justify this commission in concluding that the increase was contrary to the Emergency Price Control Act, or otherwise unlawful."



PORT WASHINGTON GENERATOR—Shown being lowered from the vertical to horizontal position after stacking laminations, is the 94,118-kva., 22,000-volt, 1,800-r.p.m. generator soon to be installed at the Port Washington station of Wisconsin Electric Power Co. Photo was taken in the West Allis shops of Allis-Chalmers

Correction

In the fourth paragraph of the story headed "House Moves on Two Utility Investigations" (ELECTRICAL WORLD, July 3, 1943, page 6) reported inaccurately that OWU Director J. A. Krug informed Dr. Paul Raver, Bonneville Power Administrator, that 750,000 kw. of generating capacity would be installed in the Northwest in 1944.

Testimony before the House rules committee was that Krug informed Raver that 750,000 kw. would be installed in the Northwest during the remainder of 1943 and all of 1944.

Utilities' Seizure in Puerto Rico Upheld

Motion for dismissal of condemnation proceedings denied

Judge Robert A. Cooper of the U. S. District Court for Puerto Rico has handed down a decision which, while subject to Circuit Court Appeal, gives the federal government possession of the property of the Porto Rico Railway Light & Power Co. and the Mayaguez Light & Power Co. Motion of the companies for dismissal of the condemnation proceedings, filed by the Federal Works Administration, was denied, but a motion of Porto Rico Railway for decree of mandate was granted. The judge's decision stressed, however, that physical return of the properties is not possible because of the second condemnation.

Brief Story of Case

On June 29, 1943, the government, through FWA, was granted the right of possession of the two corporations by the San Juan district court, and compensation of $6,250,000 was approved by the court for the Porto Rico Railway, Light & Power and $1,000,000 for the Mayaguez company. The U. S. government was in complete possession from July, 1942, to December, 1942.

On July 1, 1942, FWA entered into an agreement with the Puerto Rico Water Resources Authority, an agency of the insular government, giving it, as the agent of the federal government, the management and operation of the two companies. The authority has continued in possession ever since. However, the Circuit Court of Appeals in Boston, on November 27, 1942, entered a judgment vacating the previous order of the San Juan court and restoring the properties to the two privately owned corporations (ELECTRICAL WORLD, December 5, 1942, page 5).

The federal government, on December 29, 1942, filed through the FWA and under the authority of Title II of the Second War Powers Act, a petition for condemnation of the properties in question. Meanwhile both the utilities filed motions for the restoration of their properties, together with the rents and incomes accrued during the period of government possession.

Companies' Arguments

The defendant companies stressed (1) that the condemnation of the properties would serve no war purpose; (2) that the proceeding was not in good faith; (3) that the proceeding was arbitrary and in abuse of discretion, and (4) that the true purpose of the condemnation was to take, without compensation, the defendants' franchises, going concerns, and business, without due process of law.

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County Boards to Handle Farm Wire

County war boards of the U. S. Department of Agriculture will distribute farmstead wiring to farmers under the program established by the War Food Administration to replace order P-144 (ELECTRICAL WORLD, July 10, 1943, page 73).

State and county quotas of wire have been established, to be filled from Agriculture Department's quarterly allotment of copper under the Controlled Materials Plan. Farmers who are eligible for extension of service under order U-1-c or who presently have service will apply to their county war boards for the wire they need. If their applications meet WFA standards they will be granted Copper Wire Allotment Certificates which must be presented to suppliers within ten days. Suppliers will replenish their stocks by extending the certificates.

WFA standards for the allotment of farmstead wiring require that it be used to produce additional food or to save farm labor. The number of livestock or poultry on any farm will determine the amount of wire its owner may obtain. Maximum wire for any presently unserved farm is 75 pounds, and for farms now receiving service 50 pounds. None of the wire may be used to extend service to dwellings.

This procedure is separate from that under which farmers can get up to 75 feet of wire by certifying that it is needed for farm operations (ELECTRICAL WORLD, July 17, 1943, page 9).

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Ickes Authorizes Shasta Line

Interior Secretary Harold L. Ickes has ordered the Reclamation Bureau to expedite construction of the high-tension Shasta-Oroville transmission line, for which Congress refused a specific appropriation some weeks ago (ELECTRICAL WORLD, July 17, 1943, page 6).

Priorities Awarded

Ickes said the line was recognized as "imperative" by Congress and by WPB, which recently awarded Reclamation priorities for 1,207,800 pounds of aluminum for a 230-kv. line from Shasta Dam to the Oroville substation of Pacific Gas & Electric Co. Congress had approved the line as one item of the Central Valley project in passing the 1943 Interior appropriation bill a year ago.

"The critical fuel oil situation on the Pacific Coast accentuates the urgent need for hydro-electric power from Shasta Dam to replace the output of oil-consuming steam electric plants," Ickes declared in a statement announcing the construction order. "The Shasta-Oroville line is essential for war purposes and for the full development of the Central Valley project . . . The right-of-way has been secured for a considerable distance and bids for the construction work are to be advertised this month . . . I am well aware of the persistent efforts of Pacific Gas & Electric Co. to block the construction by the bureau of the transmission line so that only the P. G. & E. would have access to the power produced by the government at the Shasta Dam power plant, which is being constructed with public funds."

P. G. & E. Contract

Ickes added that he had directed the bureau to work out with P. G. & E. a "wartime" contract for the purchase of Shasta power, in accordance with instructions of the Senate appropriations committee in 1942 and 1943. He saw "no reason why a . . . contract with P. G. & E. should not be concluded promptly."

MEETINGS

Previously Listed

International Association of Electrical Inspectors—Northwestern section, New Washington Hotel, Seattle, Wash., August 26-27; F. D. Weber, secretary, P. O. Box 70, Portland, Ore. Southwestern section, Los Angeles, Calif., week of August 30; H. L. Gerber, secretary, Room 205, City Hall, San Francisco, Calif. Western section, LaSalle Hotel, Chicago, Ill., September 13-15; F. H. Moore, secretary, 320 N. Meridian St., Indianapolis, Ind. Eastern section, New York, N. Y., week of September 20; F. N. M. Squires, secretary, 85 John St., New York, N. Y. Southern section, Roosevelt Hotel, New Orleans, La., September 27-29; C. M. Jones, secretary, 307 Trust Co. of Georgia Bldg., Atlanta, Ga.

American Institute of Electrical Engineers—National technical meeting, Salt Lake City, Utah, September 2-4. H. H. Henline, national secretary, 33 W. 39th St., New York, N. Y.

Municipal Electric Utilities Association of New York State—Annual conference, Lake Placid Club, Lake Placid, N. Y., September 15-17. T. J. McKee, secretary, 200-212 East Third St., Jamestown, N. Y.

International Association of Electrical Leagues—Annual conference, Netherland Plaza Hotel, Cincinnati, Ohio, September 16-17. O. C. Small, secretary, 155 East 44th Street, New York, N. Y.

Pennsylvania Electric Association—Annual meeting and business conference, Wm. Penn Hotel, Pittsburgh, Pa., September 23. A. B. Millar, managing director, State Street Bldg., Harrisburg, Pa.

Association of Iron and Steel Engineers—Annual meeting, Wm. Penn Hotel, Pittsburgh, Pa., September 28-30. Brent Wiley, managing director, Empire Bldg., Pittsburgh, Pa.

Week's Output Sets New Record

Following the sharp drop in output registered during the holiday week ended July 10, figures for the latest week, ended July 17, bounced back once more over the four-billion kilowatt-hour mark to a new high record. The amount of electrical energy distributed by the light and power industry during that latest week totaled 4,184,143,000 kw.-hr., compared to 3,919,398,000 kw.-hr. the week previous and a previous high of 4,120,038,000, registered during the week ended June 26. Figures for the latest week show a gain of 17.4 percent over last year.

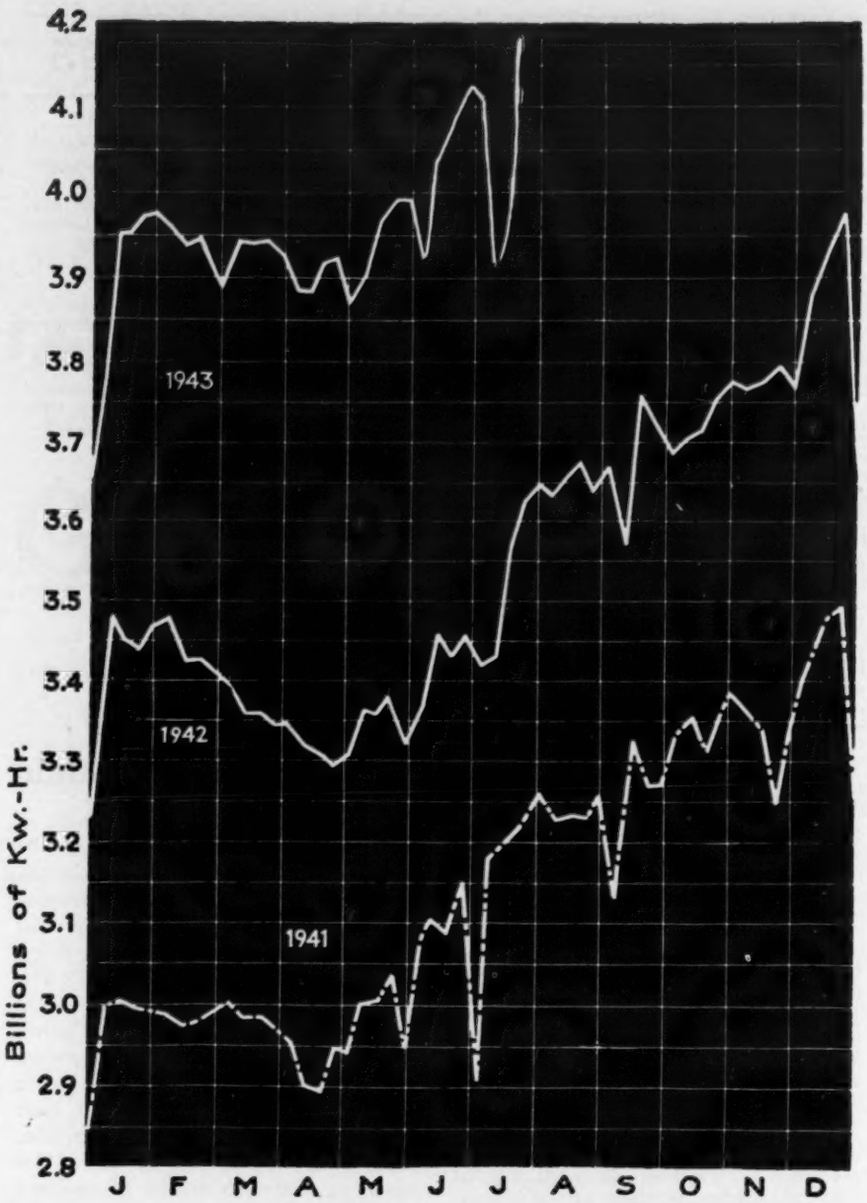
All the major geographic regions of the country increased their percentage leads over the '42 figures, compared to the week previous, with the exception of the Rocky Mountain region, which remained static at 11.1 percent gain. Biggest gain was in New England, which jumped from a 0.8 percent loss to an 11.3 percent gain.

Weekly Output, Million Kw.-Hr.

1943		1942		1941	
July 17	4,184	July 18	3,565	July 19	3,199
July 10	3,919	July 11	3,429	July 12	3,178
July 3	4,110	July 4	3,424	July 5	2,901
June 26	4,120	June 27	3,457	June 28	3,157
June 19	4,098	June 20	3,434	June 21	3,091
June 12	4,040	June 13	3,463	June 14	3,101
June 5	3,926	June 6	3,372	June 7	3,076
May 29	3,990	May 30	3,322	May 31	2,955
May 22	3,992	May 23	3,380	May 24	3,040
May 15	3,969	May 16	3,357	May 17	3,011

Percent Change from Previous Year

	Week Ending		
	July 17	July 10	July 3
New England	+11.3	— 0.8	+13.0
Mid-Atlantic	+19.0	+12.0	+20.9
Central Industrial	+13.0	+ 9.1	+19.5
West Central	+13.5	+ 8.2	+16.3
Southern States	+22.0	+18.7	+28.3
Rocky Mountain	+11.1	+11.1	+16.6
Pacific Coast	+23.4	+19.5	+26.6
Total United States	+17.4	+14.3	+20.1



Canada's May Output Rises

The Dominion Bureau of Statistics stated recently that output of Canadian central electric stations reached a new high at 3,502,819,000 kw.-hr. during May, comparing with 3,268,197,000 in the previous month and 3,174,764,000 in the corresponding month of last year.

The daily average for May this year at 112,994,000 kw.-hr. was 3.7 percent larger than the average for April, the previous peak, and 10.4 percent above that for May, 1942.

Production during the five months ended May totaled 16,269,363,000 kw.-hr., compared with 15,569,184,000 in the corresponding period of 1942.

Exports to the United States during May amounted to 236,114,000 kw.-hr., an increase of 4.7 percent over May, 1942, exports, all of which was in secondary power.

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High Stream Flow Moves Northward

June stream flow and ground water levels in the United States and Canada followed the May pattern essentially except that the belt of excessive stream flow moved northward. Central and southern Arizona and southwestern New Mexico saw the spring drought grow more serious.

Above-normal stream flow was recorded in the Lake Winnipeg area, the St. Lawrence, Upper Missouri and Mississippi River drainage basin and the Atlantic Seaboard from the Maritime Provinces to South Carolina. June records were broken in Minnesota, Wisconsin, Michigan and Quebec. Excessive floods occurred in Montana, Minnesota, Wisconsin, Iowa, Nebraska, Kansas, Manitoba, Ontario, Quebec, Vermont and Maine. Stream flow was normal to high in Montana, Idaho, Washington, Oregon and Nevada.

Southwest and Southern states continued with an unfavorable water situation from Arizona to Florida. Reservoir storage for irrigation apparently is sufficient, but carryover will be smaller. Storage for major power, municipal and industrial use continues to be satisfactory. Stream flow continues deficient throughout the northern part of the Columbia River drainage basin, the Colorado and Rio Grande River basins, tributaries of the Ohio and south and east tributaries of the Lower Mississippi.

SEC DECISIONS—HEARINGS

In a new series of rulings, issued last week, the Securities and Exchange Commission:

PERMITTED PAYMENT by International Utilities Corp., out of capital or unearned surplus, of a regular quarterly dividend on August 1 on its $3.50 prior preferred stock, at the rate of 67½ cents per share on the 95,946 shares of such stock presently outstanding, the aggregate amount of the payment being $83,952.75.

DISMISSED ITS PROCEEDINGS against the Cities Service Co.'s four service subsidiaries, including Electric Advisors, Inc. Proceedings were instituted against the companies in an SEC order of May 24, 1943, following the commission decision in the Columbia Engineering Corp. case. New principles adopted in that case (ELECTRICAL WORLD, March 20, page 91) provided that service companies stick to operating services as distinguished from managerial, executive or policy-forming functions. The Cities Service service companies filed amendments with the commission which, in effect, met all the objections of the SEC staff to their operations.

APPROVED THE PROPOSAL of Braddock Light & Power Co., North American Co. subsidiary, to issue eight unsecured promissary notes in the aggregate amount of 27,276 in substitution for like notes previously issued to certain non-affiliated persons, and to reacquire and retire the latter notes.

GRANTED THE REQUESTS of both United Corp. and United Gas Improvement Co. to be made parties to the proceedings respecting the recapitalization of the Commonwealth & Southern Corp., now pending before the commission. The C. & S. plan proposes a change in capitalization to a single class of common stock.

APPROVED A PLAN looking toward the dissolution of Central Arkansas Public Service Co., involving the cash sale of four subsidiaries, to effect partial compliance with "death sentence" orders of the commission. The plan was filed by Central Arkansas and its parent, Federal Light & Traction Co., and provides for the sale of three companies in Hot Springs, Ark. to Gus B. Walton of Little Rock for $3,746,672.

PERMITTED TO BECOME effective a declaration filed by Electric Bond & Share Co. regarding a proposed expenditure by the holding company of $15,000,000 in market purchases of its own preferred stock on the New York Curb Exchange.

APPROVED THE APPLICATION of South Carolina Electric & Gas Co. for exemption from the provisions of Section 6 (a) of the Holding Company Act of the issue and sale of $20,000,000 principal amount of first mortgage bonds, due 1973. Proceeds of the financing will be used to redeem approximately $21,000,000 of bonds of Broad River Power Co., Parr Shoals Power Co. and Lexington Water Power Co.

GRANTED Manufacturers Trust Co. of New York a limited exemption until September 15 from the provisions of the Holding Company Act applicable to it as a holding company with respect to its ownership of the voting securities of Marion-Reserve Power Co., Eastern Minnesota Power Co. and New England Public Service Co. The bank has received an offer from Ohio Edison to purchase its interest in Marion-Reserve, the commission was informed.

AUTHORIZED Transportation Securities Corp. to dispose of all its transportation assets and apply the proceeds, with other funds, to the reduction of outstanding income notes owned by its parent, Commonwealth & Southern Corp., and by Ohio Edison Co., another C. & S. subsidiary.

Hearings Scheduled

JULY 26: Hearing on a proposal of Consolidated Electric & Gas Co. to sell to Lynchburg, Va., investment bankers all of the capital stock of Lynchburg Gas Co., consisting of 7,890 shares, no par value, for $347,000 in cash.

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Wisconsin Upholds Tax on Dividends

Wisconsin state supreme court, in five separate decisions, has affirmed its previous ruling that the Wisconsin tax on the privelege of declaring corporate dividends was constitutional, and that it applied to foreign corporations doing business in the state.

Four Wisconsin utilities—Wisconsin Gas & Electric Co., Wisconsin Electric Power Co., Wisconsin-Michigan Power Co. and Milwaukee Electric Railway & Transport Co.—which combined their action in one suit, and four other companies organized outside the state, protested against assessments of dividend taxes amounting to nearly $100,000. The protests had been filed after litigation in which the dividend tax law was upheld by the U. S. Supreme Court.

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Kentucky Utility Cited on "Write-Ups"

The Federal Power Commission last week directed the Louisville Gas & Electric Co. to show cause within 30 days why it should not be ordered to dispose of over $20,000,000 in "write-ups" and other amounts representing excess over original cost.

In detail, the order directs the company to show cause why the FPC should not direct that the utility classify the net debit amount of $839,212.94 in Account 100.5 (electric plant acquisition adjustments) and submit plans for the disposition thereof; classify a net debit amount of $6,980,230.07 in Account 107 (electric plant adjustments), submit plans for the disposition of $6,960,108.24 thereof and dispose of the remaining $20,121.83 in the manner recommended by the commission; and classify $12,965,806.13 in Account 108.17 (common utility plant adjustments), submit plans for the disposition of $1,560,481.61 thereof and dispose of the remaining $11,405,324.52 in the manner recommended by the commission's staff.

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Approve Associated Unit Dissolution

The Securities and Exchange Commission has approved a plan for the dissolution of the Panhandle Public Service Co., wholly owned subsidiary of Associated Electric Co.

The plan calls for the sale of all of Panhandle's utility property and assets to Northwestern Electric Co-operative, Inc., for a base cash consideration of $175,000. Of the proceeds from the sale, Panhandle will use $174,801 to redeem its first mortgage bonds, series A, 6 percent, due 1945, in the face amount of $173,500, all of which are owned by Associated Electric. Panhandle will then dissolve.

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$45,000,000 Refunding Proposed by N. Indiana

Northern Indiana Public Service Co., a subsidiary of Midland United Co. and Midland Utilities Co., has filed application with the SEC for authorization to issue and sell $45,000,000 of first mortgage bonds, series C, due 1973, at not more than 3¼ percent. Proceeds would be used, together with other treasury funds, to redeem $45,000,000 principal amount of presently outstanding first mortgage bonds, series A, 3¾ percent, due 1969.

Utility Reports

	Net Income 1943	1942
*American Gas & Electric and subs.	$11,103,084	$13,255,938
*American Power & Light and subs.	14,271,248	7,341,814
*California Electric Power and sub.	976,718	800,555
*El Paso Electric (Texas)	579,116	596,548
*Gulf States Utilities	1,858,315	1,850,025
*Savannah Electric & Power	234,481	169,135
*Washington Water Power and sub.	2,824,047	1,912,886

*Twelve months ended May 31.

WHAT'S AHEAD IN

LIGHTING

By S. B. WILLIAMS, *Editor*

LIKE EVERYTHING ELSE, lighting promotion will pick up after the war where it left off when material shortages brought limitation orders. There will be a few new pieces of equipment, but generally speaking there will be little change at the beginning.

This, however, isn't going to last for long because the war influence and some trends that were started before the war are going to be reflected in some marked changes. Just what these changes will be is, of course, not known. We do know, however, the direction they will probably take.

Design

Starting a long time ago and picking up momentum during the war is a trend toward simplicity. We find this in architecture and music and we shall find it greatly emphasized in lighting. Obviously, great forests of large hanging fixtures do not harmonize with any such trend.

The linear sources lend themselves to this trend, provided the designers can be separated from their past alliance to incandescent sources. Design based on filament practices has but emphasized all of the defects in appearance. This will be corrected.

Practice

In one aspect the war was fortunate in that it gave people time to think before the pendulum swung too far to the side of higher lighting levels as the only measure of good lighting practice. How far can we go in upping the foot-candles before we bump into some danger signals? We are at the point now where people are beginning to say not quantity but quality first. The light must be comfortable.

This, plus the new sources with their own problems, plus the changes coming in application of light, have made it apparent that while there may be more standardization in lighting practice, there will be less of the sameness to layout. Another way of saying the same thing is that emphasis will be placed more on lighting and not so much on the fixture.

Obviously this is a job for a trained illuminating engineer, and we have every reason to expect that in the future more and more lighting jobs will have benefit of consultation with an experienced illuminating engineer.

Education

But the bulk of the jobs will have benefit only of the knowledge of the salesman. To do this job with any degree of success he must know a lot more than he does now. How will he get this knowledge? That's one of the major problems that faces the lighting industry. More people are realizing the importance of a program of education in the fundamentals.

This is a program that should take the first position in any planning. Unless we do it now we may find ourselves in a post-war market that leaves no time for individual improvement. It's very hard to convince salespeople that they need to know more about the products they are selling when the business is so good it almost flies in over the transom. These post-war jobs must be done right if we are to maintain our hold and that is going to require a sales force better equipped with an understanding of fundamentals.

Nor are the salesmen alone in needing reeducation. There are the groups of consultants in the traffic field and architects and merchandise managers and industrialists, who, worse than not knowing, have in too many instances a little knowledge, and that we know is a dangerous thing.

It begins to look as though the means used to educate these people either did not take or else it was spread too thin to be of any real benefit.

War Riches

From the war itself we shall get riches. The industrial field, for instance, always backward on lighting, has taken the lead away from other prospects. It is the big and shining example of lighting benefits when enough light is used. Are people who have worked in these well-lighted war plants going to be satisfied after the war to work in semi-darkness? The answer is obvious. War industry lighting has without a doubt pushed lighting not only of industry, but all other occupancies, ahead by almost a full decade.

Wiring

Not all of the war plant lighting will remain as is after the war for several obvious reasons. Some better equipment may be used and the wiring in many instances will be changed for more local control. There may even be changes in types of illuminant.

From the war necessity for conservation we have received some new ideas on wiring and on voltages for lighting circuits. The inertia that coupled 110 volts to lighting so long as filament was used appears to be broken.

Some substitutes and some practices came out of the war that may find their way into peacetime use.

Sources

The light source of the future is definitely fluorescent but there will be early changes—changes brought about very largely by the insistent demands of the customer. It hasn't been easy after a lifetime with trouble-free incandescent lamps to accept quietly the auxiliary troubles of fluorescent tubes. The troubles, however, will all be cleared up reasonably quicker, even if it means some different tube characteristics.

It is interesting, however, that two conflicting forces springing out of the war will stimulate desire on the one hand through experience in the modern well-laid out lighting, while reduced light in the dimout and blackout can be expected to create desire because of want. A light-starved people in our coastal areas may have learned how to get along without light, but they have also learned how to get along without butter and roast beef and coffee and silk stockings and pleasure driving. Does anyone think that these lacks will be permanent just because people have learned how to get along on less?

Markets

From this vantage point lighting looks like one of the "naturals" in immediate post-war markets. Hardly a phase of it does not present possibilities. Furthermore, if we take the long-range point of view we must not forget that virtually everything installed pre-war is now obsolete, or will be obsolete by the time we get around to it. In other words, the long-range market includes the complete relighting of America—and we can't wait too long to get it done. That really is something to get enthusiastic about.

The more detailed analysis of future trends in lighting contained in the following pages represents the combined thinking of more than two hundred manufacturers, engineers, lighting specialists for utilities, architects, traffic and highway engineers, department and chain store merchandisers. It was interesting to see how often a number of people widely separated by location and occupation had arrived at the same conclusion.

This study is offered in the hope that it may be of service in organizing the preparations of the lighting industry for the post-war market.

LIGHT SOURCES

Hardly anybody seems to have a thought for anything but fluorescent so thoroughly has it been accepted as the light source of the future. There will, however, be others that will have a definite use. Postwar will definitely be the period of transition from filament to fluorescent. The period when the source will have more effect upon the installation than the selection of equipment. This in itself is important because after the transition is substantially on the way there will be another change when the equipment begins to compete for attention with the source. And until that time arrives the lighting industry will be working under a strong handicap. The source in and of itself is nothing more than a tool, it's the quality of the lighting that is important.

What Is the Light Source of the Future?

Low-voltage fluorescent lamps are expected to supply the lion's share of the new interior lighting market. That doesn't mean that the trade or the consumer are entirely satisfied with the fluorescent lamp in its present state, only that they are better pleased with it than incandescent. Filament lamps had about reached their ultimate in efficiency, while fluorescence has only begun its long series of improvements. There will, of course, be other gaseous discharge lamps besides the hot-cathode tube, and it wouldn't be surprising to learn in another decade or two that the present-day source was but the progenitor of a number of even more efficient light sources.

Does That Mean that Incandescent Is Finished?

By no means. In the first place, the present capacity to produce fluorescent lamps and equipment is not sufficient to supply the whole country were it to demand modernization overnight. There will therefore be a market for filament bulb replacement for some time. There will also be many special uses where size or shape will require use of the filament source. Its low first cost, rugged construction and freedom from starting difficulties will prolong its usefulness, especially in short-hour installations. It will continue to be used as a mix where color correction is needed, but most important of all it will continue to be used in homes, because too little work has been done on residential application of fluorescent to make it as acceptable for that market as the others. There can be little doubt that as soon as the necessity for three shifts in industry ceases and lamp replacements become less frequent filament production will start a sharp decline. It will be years, however, if ever, before the usefulness of incandescent lighting is ended.

What Place Has Cold Cathode?

A very definite place. The only question is whether it shall wind up in a corner with a certain rather limited range of application or become competitive with hot cathode for general lighting. Too little factually is known of this offspring of sign lighting to make positive predictions. Certainly it has won friends and interest is widespread and growing. The ability to shape it is intriguing to many people, not only for decoration but for use in place of the incandescent lamp in portables. One of the major hurdles this form of lighting will have to overcome is the high voltage. Research, however, should produce a system sufficiently safe to permit its use in homes.

Another problem seems to be suitable fixture design and attractiveness.

Is Luminescent Light in Tomorrow's Picture?

Decidedly yes. While the practical use of this type of light has really only just begun, there are already those who see in it very definite opportunities for low-intensity lighting. It may have an important place for decoration and display and merchandising. The very economies of the thing will cause it to replace long-hour current-consuming light for direction and location marking.

What Other Sources Will be Used?

Without getting into the very special applications, the new high-intensity mercury unit appears to offer promise for the lighting of large high-bay areas.

What Improvements Can Be Expected in Fluorescent Tubes?

(a) *Starters.* The public and the trade do not want starters, so it is safe to assume that they will be eliminated. The same positive start that incandescent has is wanted and probably will be had before long.

(b) *Ballasts.* While a necessary evil to prevent runaway current, there is so much dissatisfaction expressed that it can be predicted that this condition will be improved. In fact, it is just such auxiliary troubles that give rise to the widespread interest in cold cathode. If these difficulties cannot be corrected, then positions of hot and cold cathode might very easily be reversed.

(c) *Life.* Tube life continues to grow. Starterless tubes may cause a momentary change in the direction of the curve, but it is doubted if it would be for long.

(d) *Output.* There is a demand for higher initial and maintained output. A continued improvement in candlepower maintenance can be expected.

(e) *Efficiency.* There is no indication of any halt in the trend of improved efficiency. Possibility seen of new phosphors with greatly increased efficiency.

(f) *Sizes.* A demand for larger sizes in shorter tubes cannot be met. In fact, it is doubtful if we will have much larger sizes for some time; they are impractical at the moment.

Will Shapes Be Available After the War?

Shapes are always available with cold-cathode tubing but there is reluctance to offer shapes with hot cathode because of the replacement problem. This matter, however, will be settled by the consumer demand. If enough people want them a way will be found to supply the demand and the replacement problem quickly solved with standard shapes.

Can Improved Maintenance Be Expected?

Yes. The elimination of the starter and simplification of the ballast will help considerably, as will also simpler fixture design. At the same time, there is a possibility of maintenance organizations, similar to window-cleaning outfits, taking over the work on a schedule basis. Cleaning expense is seen by some as reason for 5-ft. superseding 4-ft. tube. Until many present maintenance problems are eliminated, fluorescent use in the home will be slow.

EQUIPMENT

It has been unfortunate, but nevertheless true, that lighting has been limited not only by technical but also esthetic characteristics. Anyone could have produced lighting equipment that would give the desired quantity and quality of light, yet to have something that was not an eyesore was another thing. There is reason to believe that with tube sources we can correct this situation even if it means going to the absurd in fluorescent fixture design before changing. And if that were all perhaps we might not have to take too long to do the job. However, we now have to add the necessity for easier maintenance. This too will be solved in some simple manner.

We can expect nothing startlingly new until well after the war. If the customer demand is large any introduction of new ideas may be delayed. There will be some changes to accommodate changes in source. New materials may cause some variations. Thus it is apparent that we can start planning now for post-war activities pretty well convinced that there is nothing on the horizon so new that its announcement would throw such plans into the trash pile.

Is the Pendant Fixture on the Way Out?

Apparently. Fluorescent lighting, by the very bulk of the fixture needed to house a number of long tubes, has merely amplified the dissatisfaction with hanging fixtures. The trend appears to be either built-in lines of light or ceiling mounted, preferably flush equipment. Pendant fixtures have been too obtrusive. The future trend is expected to be in just the opposite direction.

What Changes in Fixture Design Are Seen?

At the beginning of the peace era the same designs will be offered as before because in most instances new tools for new designs won't be ready. Changes will come along a little later.

(a) *Simplicity.* In line with the turn against the

pendant fixture and against obtrusiveness is the trend toward simplicity. This will express itself not only with respect to appearance but also with respect to ease of maintenance.

(b) *Built-In.* In place of the customary forest of fixtures, we may expect lines of light flush with ceiling or behind some diffusing plate of glass or plastic. While there is no activity at the moment, due to limitations, the consensus appears to favor the latter for the long trend and the former for the immediate future.

(c) *Source Effect.* There is a growing criticism that fluorescent fixture design is but an adaptation of that used for incandescent. Radical designs fitted to the new source, such as built-in lighting, may be expected. Nevertheless, an enclosing globe of larger diameter is being suggested for fluorescent to take the place of the popular incandescent enclosing globe.

(d) *Cost.* There is a feeling that present fixture costs will hold fluorescent back. On the other hand, the thought has been expressed that design must be improved. Perhaps both of these can be achieved as the market settles down to one of volume production.

What Materials Will Be Used?

For light transmission glass will have to share the field with plastics. Reflecting surfaces, according to present indications, will be the same as before the war, except that some consideration is being given to magnesium. War substitutes are given faint praise. It will be some weeks before any reliable data on the use of these substitutes over a reasonable period of time can be had. Such data will have a lot to do with determining their use in the future. Manufacturers of industrial equipment are looking forward to the time when the limitations will be lifted and they can go back to steel. The belief has been expressed that greater use will be made of plexiglas to pipe light around the corner.

What Effect Will Tube Life Have?

As tube life extends to four thousand, six thousand and longer hours, and, as night work falls off, it seems probable that unit assemblies consisting of tube, accessories, housing and transmitting medium will be built; when the tube fails the whole thing is thrown away. This will reduce maintenance and assure the customer of the latest development each three or four years that a new unit was needed. Especially will this be the simpler way of relamping jobs built in behind a luminous ceiling.

Has the Fly-By-Night Manufacturer Been Washed Out?

War limitations have pretty well dispersed this group, but a great many expect a new crowd after the war lured by a market eager to be served. How much of this is fear and how much a real threat is not known. However, the public knows more about fluorescent than it did when the first swarm of tinsmiths descended upon them. Moreover, the design and installation practice have so changed that the fly-by-night will find the going much more difficult even though a hungry demand exists. It might be intimated that this fear, which stems largely from those supplying energy, can be greatly reduced through preparation of the market—a thing the fly-by-nights can't do.

What About Certification?

There is an increasing demand for certification because of the new and unknown producers, as well as the need for better illumination quality control, whatever be the light source.

PRACTICE

Changes in practice are evolutionary, so we need not expect any big change immediately. There will, however, be great changes over a short period of years, the seeds having been almost all sown before the war. In most other industries the war brought practices that were revolutionary, but not so in lighting. Some new methods were tried but there hasn't been enough time to know what results can be expected. After the war we should expect more experimentation, especially with new ideas that have been bottled up for want of material or market.

What Will Tomorrow's Intensities Be?

Higher. The effect of the higher levels of illumination in war factories is expected to be felt in all other occupancies. Labor that has worked in those plants, it is held, will not be satisfied with less in peace time. Industrial lighting, in other words, which always before has trailed the procession of improved lighting, is now looked to as the bellwether. This impetus is expected to carry intensities forward to the 100-foot-candle level or even higher for general illumination.

Will There Be Any Limit to Intensities?

For general illumination, yes, but not for localized lighting. While some predict as high as 150 foot-candles for general lighting, there seems to be a growing conviction that we should not be too eager to reach new foot-candle heights until we have first found out how to keep quality of light in step. The great emphasis in shooting up lighting levels will come apparently from the introduction of more local lighting. More studies, however, are needed on the use of fluorescent for localized light.

Does That Mean More Attention to Quality?

Decidedly, yes. As great a swing toward quality can be expected as there has been toward quantity in the past decade. This will be reflected in design, promotion, educational programs. As much of this decision to concentrate on quality comes from those who have a collateral interest in higher levels, the power people, we must admit the need. In the meantime there is urgent need for more illuminating engineers and for lighting salesmen who understand the fundamentals of quality and how to apply them. A strenuous period of education is anticipated.

Will More Attention Be Paid to Utilization?

Naturally. The reflection factors of walls, floors, machinery, furniture, even clothing take on a new light as more attention is given to quality. Some of this is due to an effort to improve seeing through contrast, some to an effort to reduce brightness contrast and thereby bring what is spoken of as a beneficial psychological effect, which in ordinary conversation simply means more comfort, and a lot to an effort to utilize as many of the generated lumens as possible. A greater knowledge of paints and colors is called for. On the basis of this reasoning, white floors might be expected to be used more as an auxiliary to good lighting.

Is There Any Change Relatively in Direct and Indirect?

Yes. Fluorescent doesn't lend itself so easily to indirect and besides it would be less objectionable for the lighting to provide its own ceiling. Thus we can expect not only large areas of low brightness in both ceilings and walls, but we can look forward to fairly uniform luminous ceilings behind which the lighting is concealed. There will also be lines of light either louvered or behind transmitting panels, and ceiling mounted units. So long as the brightness stays within comfort levels we can expect direct lighting. Factories have always had direct lighting, but an installation with indirect mercury on a concrete roof might start something new. The lines of light were an effort to get away from the obviousness of large fixtures. Because it, too, is obvious and decidedly radical, it may only be a transition method until the large areas of low brightness are better developed. Incidentally, this uniform ceiling practice can be expected to bring that so much desired uniformity of lighting levels over an area.

What About Color?

The use of color for display and for psychological effects is expected to increase. Greater attention, as has been stated, will be given to the color of surroundings. More research is indicated to find unobjectionable lighting colors for certain merchandise, including foods. Daylight quality is demanded by the merchant, but at the same time he is conscious of the aversion, particularly of women, to the effect of mercury lights on the skin. Color is demanded and will be used more and more after the war, but until we know a whole lot more about it than we do now, it is going to be a headache.

Will Reduced Lighting of Dimout Leave Any Mark?

It will have a decided effect upon quantity and quality of all forms of outdoor lighting in the greater use of shielding. In the past we have been very wasteful of lumens out of doors. Some knowledge of the more effective use of contrast under lower wattages might carry over. In general, however, the effect of the dimout appears to have built up an appreciation of good light and a desire for more light.

Has the War Brought Any Practices That Can Be Used Afterward?

Yes. The most important are perhaps the things that were found out in wiring design under the necessity to save copper. As a result, interior lighting voltages will increase, not to save copper so much as to get more load on equivalent circuits. This will reduce wiring costs. The higher voltage will benefit the lighting equipment. The voltage limit will be determined by the regulations of the National Electrical Code. Our guess at the moment is the 240-volt range for commercial interiors with individual fixture control and the 450-volt range for industrials.

There is also the possibility of greater use of the series circuit.

A number of inspection lighting problems found war solutions that can be used in peace operations. Likewise, some special problems such as underside lighting and large floor areas. In general, however, the war in and of itself has not brought much that is new that will have a permanent place in our peacetime operations, simply because the problems did not call for entirely new engineering concepts.

Is That True of Maintenance?

Not altogether. What the war has done has been to emphasize the problems and to point to what seems the only practical answer, namely, maintenance by contract, the same as window washing.

Is Any Architectural Integration Seen?

If, as expected, more and more lighting will come from built-in sources, it is obvious that there must be a new architectural approach to lighting. In the future it cannot be left to the vagaries of competition. In many respects the interiors will have to be built around the lighting.

Will Lighting Be Coordinated With Any other Utilty?

A greater affiliation between the lighting and air conditioning is seen. In the provision of recessed or concealed lighting, space must be made available for the duct work. The two systems in all probability will be worked out together. The lighting equipment and sound proofing companies may cooperate to produce a standardized ceiling for built-in lighting. It is also suggested that the lighting system be equipped with germ-destroying lamps for control of colds and other contagious diseases. Because of the interest this seems likely to make considerable progress, especially in public toilets and in places of assembly, such as offices, schools, theaters, factories.

A number of people show interest in low-temperature, radiant panel heating using incandescent lamps. It has the advantage over steam, on which considerable research work for this purpose has been done, because of its quick and positive control.

Will Automatic Control Be Used More?

There seems to be a feeling that electronic automatic control of large area lighting will go forward much faster after the war. There may be something to that belief if for no other reason than the great public acceptance that is being built up for electronics generally.

Will Practice Get Any Help From Research?

It seems likely that we shall have more lighting research, both with respect to design and to quality and its control. Some formal action is being discussed which offers important possibilities. One reason why progress might be expected is that the new light sources are bringing a growing recognition of some of the problems scientists have been discussing, with a desire for more information and data.

MARKETS

The feeling is rather general that there will be a large demand for improved lighting, although there are some who believe that the dimout has taught people how to get along with less light, to overcome the effects of which will require more intensive promotion. On the other hand is the point of view that in the light-starved areas people will be so hungry for light that they will go to the other extreme. There is no denying, however, that there is a large and growing backlog of war-deferred buying. All who were unable to get new lighting equipment during the war are quick prospects.

One thing is recognized and that is the ability of the manufacturers quickly to get back into production. For the most part they will not have to go through any reconversion process but will be ready to turn out equipment as fast as they can get material. This would seem to put the lighting industry into the market earlier than most others and in a position to be one of the first to take advantage of the pent-up civilian buying demand.

Not all markets are viewed as offering the same post-war opportunity but there is a general agreement that the commercial lighting market will be the first to come back.

Is Price Going to Be a Factor?

Among certain architects and utility salespeople the cost of fluorescent fixtures is held to be detrimental to relighting in large volume. Possibly some further attention to repetitive manufacture will bring lower costs.

What Are the Possibilities for Standard Fixtures?

There is a definite trend toward standard chassis. In fact, there is good reason to believe that much of the concealed lighting will be done in a tailor-made manner using standardized equipment.

Will Voluntary "Brownout" Leave Any Permanent Scars?

Not necessarily. This conservation scheme, which, when the details are released, will probably be felt to be more severe than the dimout, should have a little different effect from the dimout so far as post-war buying is concerned:

The dimout is not concerned with fuel saving—merely prevention of light from adding to the sky-glow. The brownout is exactly the opposite, which should mean, if it is to be practically effective, a reduction in lighting hours. There is little change in lighting technique under such a condition—only a reduction in time. It doesn't, then, give the same incentive as the dimout restriction to post-war buying. However, if certain daytime lighting is stigmatized as unessential what effect will that have on sales in that field? Its essentiality will be determined by the rapidity with which it is restored.

A—Commercial

What Part of the Commercial Market Appears to Offer the Greatest Immediate Possibilities?

The answer pretty generally is the relighting of small stores. Campaigns will be built to crack this market just as soon as the war is over and restrictions on the use of materials for civilians are lifted. In addition are markets for window lighting in dimout areas, gasoline service stations when rationing is lifted, return of thousands of new stores forced out of business by war shortages. If the war lasts another year, the mortality in small retail light and power customers will have exceeded a quarter of a million in number.

The larger stores will also offer an active market. Many have already made tentative plans for remodelling. It is reported that chains particularly are active in this direction.

Because of the changing about that is bound to occur when we return to a peace economy, there should be a big market in office relighting.

Are Any Store Merchandising Changes Contemplated that Would Affect Lighting?

That question was asked but the answers gave no indication of anything at this time. Store managers ask that the lighting do not compete with the merchandise. If possible, veiling of the source will be desired. More light is wanted, but dissatisfaction is expressed over the fading effect fluorescent has on certain wares. The use of fluorescent in display cases is expected to increase, but here there is a demand also for smaller overall size. If the safety feature can be satisfactorily settled perhaps this is a place where cold cathode would shine. More esthetic effects, greater use of color and decoration to attract customers can be expected.

B—Industrial

Will Industrial Lighting Go Into a Tailspin?

Feeling among the trade is somewhat mixed on this question. There are those who feel that industrial demand for lighting will be non-existent for some time after the war due to the degree to which it advanced during the war. Others take the opposite stand, but for the very same reason. We fall in with the latter group. There are millions of workers who will change jobs after the war and will be dissatisfied with poorer lighting than that under which they worked during the war. Then there are the plants that for one reason or another were unable to relight during the war. The rehabilitation of manufacturing plant will by no means be confined to reconverted war plant. And finally there is the question of competition. Lighting has been given credit for a share in the job of speeding up war production. Certainly all of the important war plants had the best and latest in lighting. Others after the war who will have to compete with them will want equally good lighting.

Will Dismantled War Plants Flood Market With Used Equipment?

In the absence of any plans to dispose of war-used materials it is pure speculation to take any position on this question, although both sides have takers at the moment. Perhaps the best answer will be found in the experience following the last war. One thing certain, this dismantling, however much or little there is of it, cannot come until some

time after the war, so if there is any volume of used equipment dumped on the market it shouldn't affect the immediate post-war market.

Will Modern War Plants Need Any Relighting?

From the standpoint of lighting alone the greater percentage of these plants would probably need no change. However, because they were to be around-the-clock operations throughout and since it would save circuit copper, these plants were designed for little or no local circuit control. Under peace conditions the saving in light might soon offset the cost of rewiring, so considerable of this may be expected. Then, of course, there are the plants that were thrown together so hastily that good engineering was not used. Lighting equipment of the stripped kind necessitated by limitation orders will be replaced in some degree.

One interesting point of view is that in some instances a plant survey after the war may show that it would be cheaper in maintenance costs to replace existing small units with a smaller number of 3-kw. mercury units.

C—Residential

What Are the Immediate Post-War Possibilities?

There are some indications of a relighting market using fluorescent. There may be some kitchen and bathroom relighting campaigns. The big market, as usual, will be new construction. This is estimated to exceed a million new residences a year for several years, mostly in the less than $6,000 class.

What Will Be the Effect of Pre-Fabrication?

In the absence of well-thought-out distribution plans there is no way of getting any very reliable estimates of the volume of post-war pre-fabricated homes. In addition to the distribution, it is going to be necessary to find the answer to the labor problem. What position will the building trade take? Certainly the most strenuous effort will be made to market the ready-made home, which, it is to be expected, will include modern lighting.

The government and war housing units are not necessarily any indication of the design of the pre-fabricated home of tomorrow with relation to the lighting. Will it be built-in? Or will it follow the past? Since price is the important marketing feature, it is possible that the built-in feature may have to wait.

On the other hand, many of this type of house are designed around the built-in idea for everything including furniture. In those houses built-in lighting may be expected to lead the way for future design in other housing.

Will Fluorescent Be Used in Homes Generally?

It is available at the moment to the kitchen and bathroom but not to the same degree for the rest of the house. There seems to be no question, however, about the ultimate use of fluorescent throughout the home, showing up first in concealed lighting in new homes. Replacement of tubes and maintenance will require a wide educational program if and when fluorescent is widely used.

Will Fixtures Return to Homes?

Because fluorescent is a lower brightness source there is reason to believe that ceiling fixtures may return if they can be made attractive. This is not going to be easy, especially if enough light is provided. The trend toward built-in lighting, however, is expected to prevail, at least with the more expensive homes.

Brackets may possibly return in the form of low-brightness panels, which may serve also as sources of radiant heat.

Will Use of Portables Decline?

The old home as now will be very largely dependent on portables. The immediate new home likewise, but when fluorescent is built in and luminous ceilings are used there is every reason to believe that portables will function more as decoration than as needed reading lamps. And if the fluorescent is introduced into the old home properly the market for the portable is apt to suffer further.

Will Fluorescent Be Used for Portables?

There are some fluorescent portables now, but for the most part these are merely adaptations of incandescent styles. They have not proved very popular. Designers are now giving attention to coils, but these are clumsy with the hot-cathode

tube, especially if enough lumens are designed into the lamp. The cold cathode, of course, would be ideal for this application were it not for the fact that the introduction of thousands of volts into a portable lamp would probably never be permitted by the inspection authorities. It will be some time, if ever, before that is worked out in a manner that is acceptable to the sponsors of the National Electrical Code. Someone, however, will find a way to use hot-cathode tubes in a simple attractive lamp of a unique design that will make it acceptable to interior decorators and housewives.

Any Changes Seen in the I.E.S. Lamp?

There is a strong demand for a more attractive design. The suggestion has also been made that it be extended to include fluorescent portables.

What About Radio Interference?

If fluorescent tubes are introduced into the home it will be necessary for them to be carefully installed and shielded against radio interference. With the advent of television after the war, it will be more necessary than ever to keep down man-made static.

Are Any Lighting Design Changes Contemplated?

Progressively home architecture is expected to be more and more functional and all elements built in will be for that purpose. The lighting will be treated in this manner, which is but another indication of the trend toward in-built luminous ceilings.

Where more light is needed, such as in certain corners, that might be used for reading, concealed down spots are suggested. Control of luminous ceilings or coves to provide higher or lower levels depending on occasion is being discussed.

D—Street Lighting

What Is the Outlook?

Lighting of city streets and approach roads, intersections and danger spots should provide an active market after the war. Lighting of highways, except within cities, and rural roads do not appear to offer the same promise. The safety angle of street lighting is beginning to make a dent in official consciousness and already a number of municipalities are making plans to improve the night-driving seeing conditions on their streets. The cost of adequate lighting is cited by state traffic officials as holding highway lighting back. Dependence along the open road, they claim, will be placed on better headlights and reflectors for curves and signals.

Will We Have a Return to White Way?

Street lighting of the future will follow the trend started long before the war, namely, utilitarian. Even in the downtown business sections it would not be surprising to see the ornamental give way to strictly functional.

What Source Will Be Used?

More and more interest is being expressed in fluorescent and less and less in sodium. Mercury and mercury mixed with incandescent appear to be strongest.

The most definite opinion is expressed on sodium. Some people like it and see a future for it as a general street and highway lighting source. Most people, however, are of the opinion its use should be confined to danger zones. Because of its distinctive color it is held to be best used as a warning.

Underpasses, railroad crossings, intersections, bridges and especially bad curves are the types of locations that would be reserved for sodium.

The fluorescent interest is mixed. It was emphasized that in spite of the interest fluorescent equipment will have to be greatly improved before it can make much headway for street lighting.

What Changes in Practice Are Contemplated?

Spacing. Some see longer spacings, with higher lumen output. For highway lighting the use of very long spacings is suggested, the purpose of the light being directional.

Mounting height. This will be changed to correspond to any changes in spacing.

Positioning. To avoid damage to lighting poles where possible they will tend to be set back further from the road; one city has found 6 ft. to be sufficient. This will call for designs supporting a greater overhang.

Curb lighting. The greater use of curb lights on bridges and at danger points has supporters.

Will Quality of Lighting Be Improved?

The complaint against glare is still strong, so strong in fact that many traffic officials believe that overhead lighting is a detriment rather than a help to night drivers. A continued effort will be made to meet this objection.

As a result of the dimout, greater shielding will be employed post-war than before. Replacement units will have this element built into them. That means that we can expect a much larger proportion of the generated lumens on the street than before.

What Effect Will Dimout Have?

As stated, shielding will be improved and the lumens on the road increased. This will obviously affect design of equipment and street lighting. The rigid shielding of the dimout is too much for peacetime comfort, but we have learned how wasteful the former methods were. Somewhere in between is the proper place, but where? This opens a new field for study.

One thing is certain, the dimout, like nothing else, has made people conscious of the comfort of good lighting. It has also emphasized the safety factor of modern lighting. City fathers will not be opposed to expenditures for street lighting as they were before the war. Moreover, the effect will reach far beyond the dimout areas on our coasts.

What Place Will Safety Have in Street Lighting?

This apparently is the one thing that will break down resistance to improved lighting. On the other hand, the mere accumulation of before and after data is not sufficient, for the reason that many people deny their validity. Dimout accident data particularly are being protested as not giving proper weight to all other factors. The most convincing proof, of course, is found in the test stretches. Some tests are going on now in preparation for post-war. The effect of these tests by different cities, especially as they are following by installation, will be cumulative and more convincing to others.

One effect of the safety campaign will be increasing attention to intersection lighting. It is even suggested that on long highways these bad intersections be lighted a mile each side to give the driver more time for eye adaptation.

What Effect Will Changed Traffic Conditions Have?

There seems to be little doubt that we are going into a period of transportation with vehicles and road design especially changed. Obviously street lighting will have to be adjusted to the transition.

E—Outdoor Lighting

The market for sports appears particularly promising. Building exterior floodlighting is also viewed optimistically.

What About Air Fields?

The expansion in commercial and passenger flying is expected to be reflected in a larger number of airports, which will call for large increase in demand for marking lights, beacons, floodlights, ets. If the helicopter becomes commonplace, a major market is seen for landing lights for private fields in residential areas. The suggestion has been made that highways have emergency landing strips properly marked.

TRAINING AND EDUCATION

A filament lamp application was simple in comparison with using the light sources we now have to work with. Its limitations were known and there wasn't much that we could do except what always had been done. Even then many mistakes were made. Are we going to be content to make mistakes, or are we going to recognize the insufficient training of the men we are sending out to contact the public in what promises to be the biggest wave of relighting the country has ever known?

The I.E.S. has developed recommended practices for a large number of occupancies. Research organizations have worked up scientific data. Are these only for use by the experts, of which the number is small, or are they for widespread areas? Are we going to be satisfied to let competition rule the job, or are we going to use the information that has been gathered for the very purpose of helping the industry better serve the lighting customer? Prior to post-war we should see the answers to some of these questions in a well-balanced educational course widely available.

Is Need For Training Seen?

Due to the increasing complexity of lighting problems as the result of the new light sources and demand for improved quality, as well as to the threat of cheap competition, there is a growing awareness of the need for better trained lighting salespeople. There is every reason to believe that courses or outlines of courses will be developed to take care of this need. These courses will also provide the necessary brush-up for the men returning from the war.

In addition there is a growing need which will become insistent after the war for more qualified illuminating engineers. Much of the new work in more costly buildings will require special handling of the lighting, although the equipment may be standard.

If the planning is to be done in the blue-print stage instead of waiting until the building is complete, trained men are needed who can visualize the right coordination.

Is Anything Being Done So Far?

Local power companies are giving some thought to refresher courses not only for their own men, but for the salesmen of local dealers and others. A national program is in the discussion stage and the Illuminating Engineering Society has already committed itself to the preparation of a lighting handbook.

What Kind of Training Is Needed?

It must be simple and practical and include a thorough grounding on quality and how to get it, a knowledge of accepted industry standards and recommendations and an understanding of the characteristics of tubes and accessories. With it, of course, will go training in the use of modern instruments which are putting more exact qualitative engineering into lighting design.

SALES PROGRAM

Will Pre-War Programs Work?

There are so many elements not present in the pre-war selling that it would appear advisable to start anew in programming for post-war. The competition is expected to be strong and for that reason a real program is needed.

Is Any Preparation Needed?

It will be found advisable to have ready for V-day an analysis of all industrial lighting load, especially war industry, so as to be ready for reconversion. Other lists of prospects should be compiled from those that have tried unsuccessfully to improve their lighting during the war. Promotion aimed at V-day is, of course, obvious.

What Customer Education Is Needed?

It is well to assume that customers still understand little or nothing about what constitutes good lighting or what it can do. Especially is this true of the industrial customer. Even architects are far from being sold on good lighting.

In connection with industrials, an I.E.S. film, about to be shot, should be available before the end of the year.

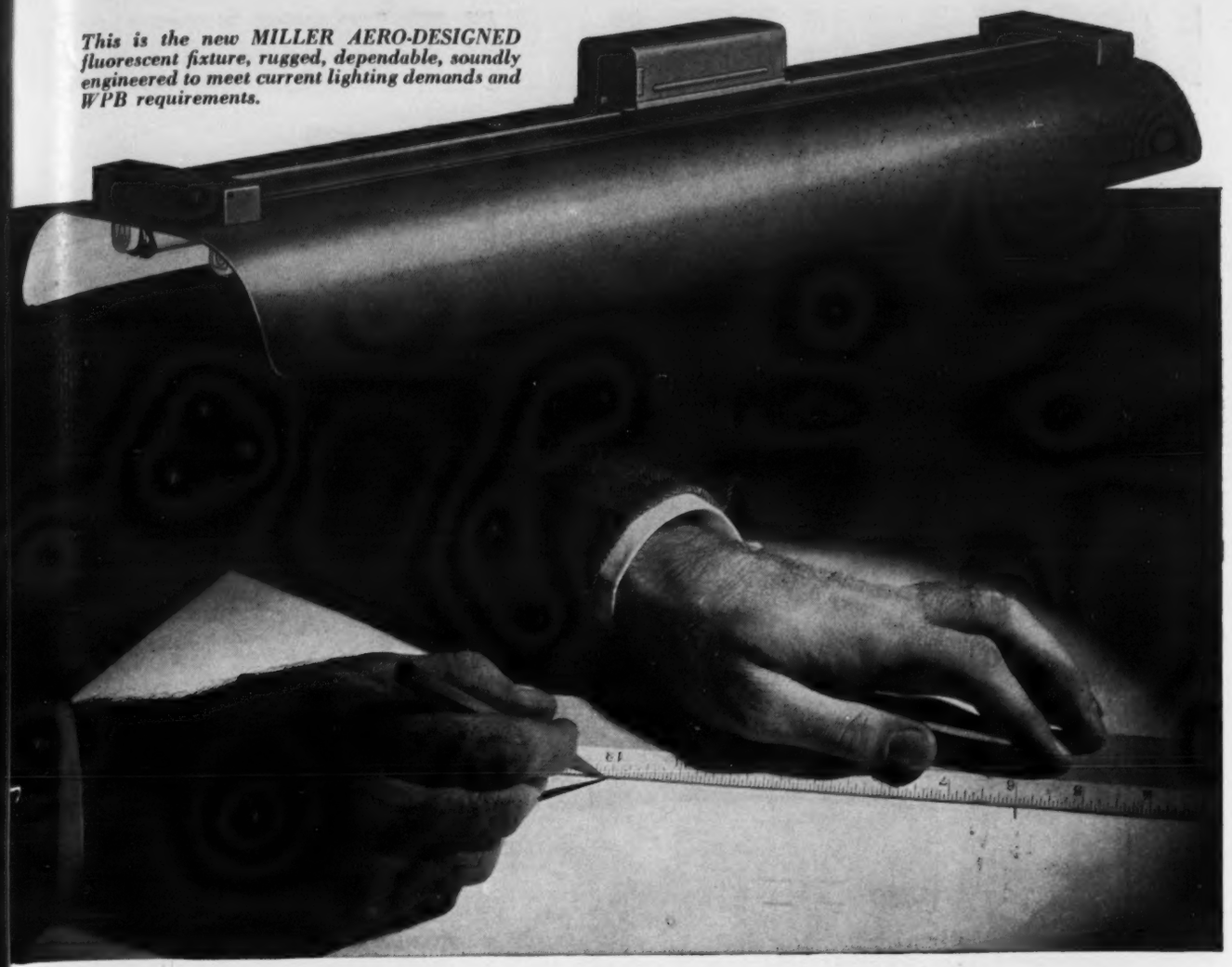
How Much Will Be New and How Much Relighting?

There are no data on which any such division of the market could be made. It is our opinion, however, that the relighting market will be much the larger. This is based upon the necessity for virtually relighting the entire country. One authority estimated 75 percent of commercial lighting was obsolete. Even if that figure were no higher, the rest of the installations will be obsolete long before we can get around to them. And even those we relight right after the war will be out-of-date before we can complete the relighting of all the rest of America. The size of the market, therefore, is limited only by our ability to sell it and to serve it.

•

Conclusion

The market possibilities look splendid. The equipment manufacturers should be ready as soon as the market. The public is in the most receptive frame of mind ever. Now is the time to prepare. Now is the time to educate the salespeople in the elements of good lighting. Now is the time to make plans, so that when the war is ended we will know what to do and be prepared to do it.



This is the new MILLER AERO-DESIGNED fluorescent fixture, rugged, dependable, soundly engineered to meet current lighting demands and WPB requirements.

MILLER Engineering makes the big difference!

LIGHTING fixtures aren't just a matter of production line assembly of reflectors, wiring and other auxiliary parts.

Every MILLER lighting development—whether continuous-row fluorescent (which we pioneered) or the new *AERO-DESIGNED* units—goes back to careful analyses of the potential user's need, intensive design engineering and test, then *—and only then—*into complete MILLER-factory production.

But good lighting . . . whether fluorescent, incandescent, or mercury (we make all three and play no prejudices) . . . is more than a matter of even the best fixtures. And that calls for MILLER engineering again, this time in the field, right on-the-scene.

The best way you can find out about this, is to call in a MILLER field engineer (located in principal cities) and let him assist you in planning lighting for efficient production requirements. Why not *today!*

THE MILLER COMPANY • MERIDEN, CONNECTICUT

ILLUMINATING DIVISION
Fluorescent, Incandescent
Mercury Lighting Equipment

OIL GOODS DIVISION
Domestic Oil Burners
and Liquid Fuel Devices

ROLLING MILL DIVISION
Phosphor Bronze and Brass
in Sheets, Strips and Rolls

WAR CONTRACTS DIVISION
War Materiel

MILLER
SINCE 1844

LOOK WHAT'S HAPPENED TO

SINCE G-E MADE THIS ANNOUNCEMENT

FACTS YOU SHOULD KNOW ABOUT NON-METALLIC REFLECTORS *for Fluorescent Fixtures!*

EFFICIENT NEW REFLECTORS RELEASE TONS OF STEEL FOR OTHER WAR PRODUCTION

INTENSIVE work by the lighting industry now has developed non-metallic reflectors for fluorescent lamp fixtures. They are efficient, light in weight and built to stand up under hard usage in industry.

No more steel reflectors may be manufactured except for dust-tight and vapor-proof units. Realizing the need to conserve metal, lighting engineers have been working for almost a year to find alternate reflector materials. They have succeeded. General Electric is proud to have been able to contribute to the research that has made these efficient new reflectors possible.

There have been, of course, many experiments with non-metallic reflectors. To make certain that the reflectors on the fixtures you get will give uniformly satisfactory service . . . that they will be strong and durable . . . you will find it advisable to buy tested and certified fixtures. Look for the Fleur-O-Lier or RLM label!

General Electric ran this announcement in electrical magazines in January 1943, showing sample fluorescent fixtures made to comply with WPB restrictions on metals.

Fluorescent fixtures bearing either of these two labels are made to rigid specifications for mechanical, electrical, and illuminating excellence; and are tested and certified by impartial experts, Electrical Testing Laboratories, Inc. of New York. You can depend on fixtures bearing these labels.

Hear the General Electric radio programs: "The Hour of Charm", Sunday, 10:00 p.m., E.W.T., NBC; "The World Today" News, each weekday, 6:45 p.m. E.W.T., CBS.

BUY WAR BONDS!

G-E MAZDA LAMPS

GENERAL ELECTRIC

TO FLUORESCENT LIGHTING . . .

RESTRICTIONS which WPB has established on the use of metals in fluorescent fixtures have been a challenge to the lighting industry. A challenge which the industry was more than ready to meet, but which presented almost insurmountable difficulties—coming as it did along with an acute shortage of lighting equipment for important war plants.

Long before the first WPB order, General Electric engineers had been working with fixture manufacturers to develop new fixtures using a minimum of critical materials. Last January, G-E announced that several types of non-metallic reflectors had been developed. Today, thanks to the ingenuity of the fixture manufacturers, a large selection of certified fluorescent fixtures, complying with WPB requirements and meeting the lighting industry's rigid specifications, are now available on priorities for war plants that need them.

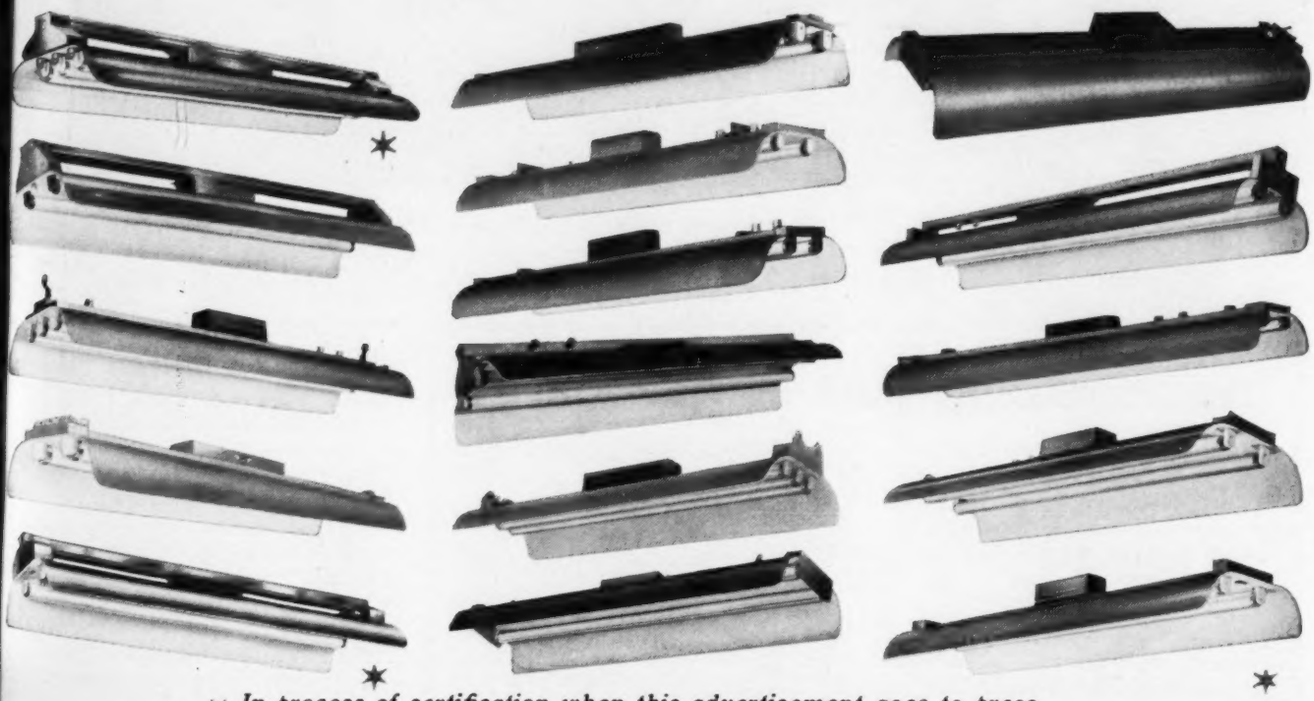
General Electric is proud of its share in this achievement—and G-E research will continue to work with fixture manufacturers toward making better and better lighting fixtures—for the duration and afterwards.

Now... CERTIFIED FIXTURES ARE AVAILABLE FROM MANY MANUFACTURERS

LIGHT—STURDY CONSTRUCTION . . . FOR CONTINUOUS ROW OR INDIVIDUAL MOUNTING . . . 2 OR 3-LAMP TYPES IN 40-WATT SIZE—2-LAMP 100-WATT SIZE

Here are a few of the many different types of certified fluorescent fixtures available from the 50 Fleur-O-Lier and RLM Manufacturers through their wholesalers. All comply with WPB conservation orders and are made by manufacturers of ETL certified equipment. (*Names of these manufacturers on request.*)

General Electric does not make lighting fixtures but is glad to recommend certified fluorescent fixtures.



✶ *In process of certification when this advertisement goes to press.*

G-E MAZDA LAMPS

GENERAL ELECTRIC

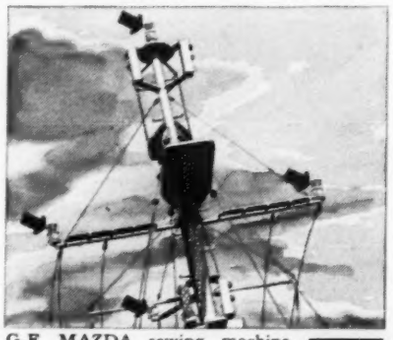
HOW G-E LAMP ADVERTISING FILLS

(Above) the G-E Hour of Charm Orchestra, (at the left), Dick Stark, announcer, reads a lighting message as Evelyn, First Lady of the Orchestra, waits her cue to play.

SEWING MACHINE LAMP GOES TO SEA . . .

Several years ago General Electric scientists developed a special vibration-resistant lamp for sewing machines. It came into wide use, not only on sewing machines but also on vacuum cleaners.

The vibration of powerful engines aboard vessels confronted the U. S. Navy with the problem of finding a vibration-resistant lamp for signalling devices and instrument illumination. G-E engineers suggested the sewing machine lamp. They went to sea, covered the ship from engine-room to topmast, helped the Navy put the G-E sewing machine lamp through gruelling tests. It proved to be exactly what was needed.



G-E MAZDA sewing machine lamp at right is used in signal lamps shown above. Filament wire is finer than a human hair but special mounting provides high resistance to ship's vibration. Each signal device (shown by arrows in drawing) contains several lamps to provide for safety and give sufficient light in colored lenses.

Wonder what an empty socket thinks about?

Peacetime surveys have repeatedly shown that an average of 10% of the nation's residential sockets were empty. Recent surveys show this average is now about 17%. Whatever the percentage of empty sockets may be in your locality normally, the situation has undoubtedly been aggravated by the war . . . and the percentage of empty sockets probably will increase as the war goes on.

One fact is clear. When the war is over, there will be a lot of empty sockets waiting to be filled. And the lighting industry's Number One activity at that time will consist of filling those empty sockets.

MAZDA LAMP NEWS

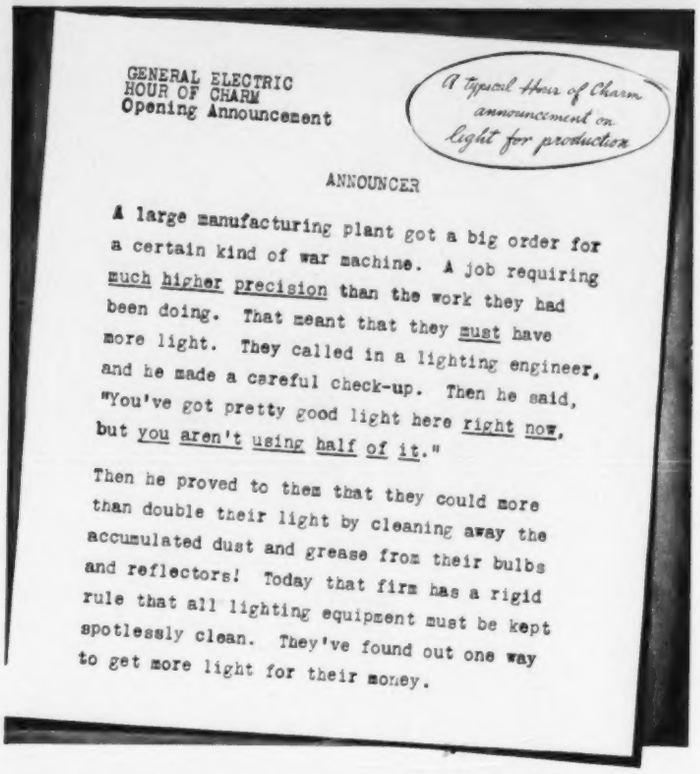
LAMP DEPARTMENT, NELA PARK, CLEVELAND, OHIO

WARTIME ROLE!

Broadcast for six and a half years, the G-E Mazda Lamp Hour of Charm is the only nation-wide lighting program on the air. Today it is reaching an audience of 16,000,000 people a month . . . telling them how to get the most out of present lighting equipment and save eyes too. It also tells the benefits of light for war production. The Hour of Charm is broadcast every Sunday evening at 10 o'clock Eastern Wartime over 125 NBC stations from coast to coast. By creating an appreciation for the benefits of good lighting, it is also helping build a big potential market for new lighting at the end of the war.

MAGAZINE ADVERTISING

G-E Mazda lamp ads in consumer, business, and trade magazines in 1943 will total more than 255,000,000 impressions. Examples of how this advertising is filling a wartime role by aiming at specific objectives are shown below.



GENERAL ELECTRIC
HOUR OF CHARM
Opening Announcement

A typical Hour of Charm announcement on light for production

ANNOUNCER

A large manufacturing plant got a big order for a certain kind of war machine. A job requiring much higher precision than the work they had been doing. That meant that they must have more light. They called in a lighting engineer, and he made a careful check-up. Then he said, "You've got pretty good light here right now, but you aren't using half of it."

Then he proved to them that they could more than double their light by cleaning away the accumulated dust and grease from their bulbs and reflectors! Today that firm has a rigid rule that all lighting equipment must be kept spotlessly clean. They've found out one way to get more light for their money.

Hear the General Electric radio programs: "The Hour of Charm", Sunday, 10:00 p.m., E.W.T., NBC; "The World Today", News, each weekday, 6:45 p.m. E.W.T., CBS.

EXAMPLES OF G-E LAMP ADVERTISING AT WORK DURING WARTIME

How many of these lighting mistakes are you making?
GENERAL ELECTRIC
Can you find the Three Saboteurs?
How a GLASS PIE PLATE helped airplanes land at night!
G-E MAZDA LAMPS
GENERAL ELECTRIC
WARTIME LIGHTING SUGGESTION
G-E Mazda Lamps
GENERAL ELECTRIC

1 Tying in with the nation's program of conservation, many G-E ads tell homemakers how to get the most out of their present lighting equipment and save eyes too.

2 Ads like this tell how lighting is helping speed production to help win the war. The advertising offers the services of trained lighting counselors.

3 This type of ad tells the story of the way General Electric Research and G-E lamps are helping the armed services. It takes a lot of lamps to fight a war.

4 Every G-E lamp ad attempts to maintain public recognition and goodwill and to keep reminding people that G-E makes lamps that stay brighter longer.

THE BEST INVESTMENT IN THE WORLD IS IN THIS COUNTRY'S FUTURE — BUY WAR BONDS!

Today:

WE ARE BUILDING BETTER LIGHTING FOR WAR

Tomorrow:

BETTER LIGHTING FOR PEACE

In practically every phase of the Nation's War Effort, Westinghouse Lighting Equipment is helping speed the day of Victory. Protective lighting guards war plants and prison camps. Industrial and commercial fixtures expedite vital war production. Aviation units make night flying safer. Marine equipment serves on the seven seas.

To provide the best possible lighting for these varied requirements, intensive research and product development work has been necessary. The "difficult" we have done at once; the "impossible" a little later. The net result is that, despite restrictions on critical materials, we are today building the finest line of lighting equipment in our history.

Naturally, the "know-how" acquired in developing better lighting for war will help us to build *even better* lighting for peace. Then, as now, you may specify "Westinghouse" with confidence. Westinghouse Electric & Mfg. Company, Edgewater Park, Cleveland, O.

Tune in John Charles Thomas, NBC, Sundays, 2:30 P. M., E. W. T.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

WESTINGHOUSE

Lighting Equipment

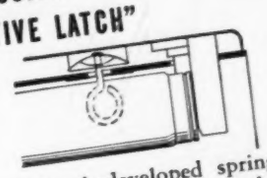
RLM
New 2FNR-40 FLUORESCENT LUMINAIRE with nonmetallic reflector. Available for 2 or 3-lamp, 40-watt (and 2-lamp, 100-watt) individual or continuous strip installations.
New Aviation CONTACT LIGHT (right) sturdily built to withstand 100,000 pound deadweight loading. Widely used for marking runways in civil and military airports.
New 24-inch SEARCHLIGHT (above) provides a high candlepower concentrated beam of light over great distances. Used for protective lighting in industry as well as for marine use on shipboard.
Westinghouse MAGNALUX, popular indirect commercial luminaire. Provides high-intensity, glareless illumination that speeds Wartime clerical and administrative work.
Type SG-10 REFRACTOLUX LUMINAIRE (below) for protective lighting around war plant property lines. New smooth surfaced globe stays clean longer, simplifies maintenance problems.
Westinghouse MILLITE (below) is built for lighting heavy service industries. Constructed of porcelain enameled steel with impact-resisting glass cover, unaffected by sudden temperature changes.
New SEADROME CONTACT LIGHT permits clippers and naval planes to land safely on the water at night. Light may be remotely controlled by radio where desired.

FILLING WARTIME NEEDS IS A FULL-TIME JOB

Supplying the lighting immediately needed for war is a full-time job here at Westinghouse. And we're staying *on top* of that job, hence are able to make prompt delivery on most items ordered. If YOU need Wartime Lighting Equipment, contact the nearest Westinghouse Office or Westinghouse Lighting Distributor.

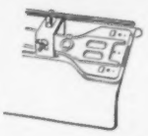
SYLVANIA *Challenge*

EXCLUSIVE "CAPTIVE LATCH"

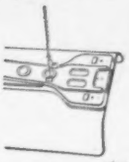


This Sylvania-developed spring-type fastener saves installation and maintenance man-hours. It stays put while lamp is in service despite any kind of vibration. It locks or unlocks with a simple quarter turn. No tools are necessary.

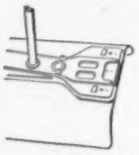
HANG IT ANY WAY YOU WANT



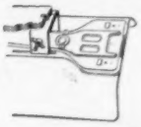
slide-grip hanger



chain mounting

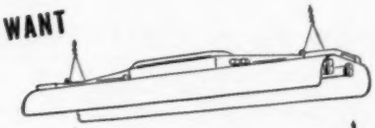


stem mounting

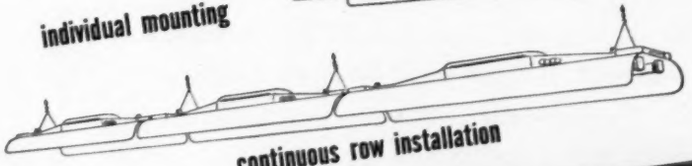


surface mounting

AND HOWEVER YOU WANT



individual mounting



continuous row installation

MORE LIGHT FROM LESS WEIGHT

Sylvania pioneered composition reflectors for fluorescent fixtures and "proved them in industry."

This composition reflector has an efficiency of 86 per cent — even higher than that of prewar porcelain-enameled metal in conventional contours.

It is fabricated to Sylvania's specifications from a strong and durable composition. Coated with MIRACOAT inside and a handsome French Gray outside, it stands up under extreme humidity and temperature conditions.

- √ Impervious to frequent washing
- √ Gives more light.
- √ Lighter and easier to handle.

INCANDESCENT LAMPS, FLUORESCENT LAMPS, FIXTU

Check these points of Superiority

- √ Easier installation
- √ Speedier maintenance
- √ Cantilever construction
- √ Simple design
- √ Standard interchangeable parts
- √ Enclosed ballasts
- √ Single or continuous row hanging

The Fixture of the Future against the field

• Compare the design and construction of the Sylvania Fixture of the Future with any other fixture now available, and it wins hands down.

It is much more than a design to eliminate the metallic reflector and cut down top-housing weight to the three-pound requirement. Sylvania engineers attained a new standard of perfection, far ahead of its time.

A revelation of simplicity, this new Sylvania fixture is available in both 100-watt and 40-watt lamp size. In either length, *one* standard fixture fills any and all industrial lighting assignments.

Unparalleled in adaptability, it may be installed individually or in continuous rows. It is fitted with knock-outs for any practical mounting. The optional number of lamps in the regular 40-watt size gives new flexibility in meeting varying foot-candle requirements.

The streamlined top-housing, constructed like a cantilever bridge, encloses the ballast — protects it from dust — provides cooler performance. The starter sockets are honestly accessible — inset from the side to avoid dust, dirt and moisture. Pull-chain switch is optional.

The Sylvania Fixture of the Future carries Underwriters' Laboratories approval and our own standard guarantee. For specifications and prices, write Dept. EW-8, Sylvania, Ipswich, Mass.

"Everything that's Finest in Fluorescent"

★ ★ SYLVANIA ELECTRIC PRODUCTS INC.

LIGHTING DIVISION, IPSWICH, MASS.

TUBES AND ACCESSORIES, RADIO TUBES, ELECTRONIC DEVICES

COLONIAL COLD CATHOD

Simple

Colonial Cold Cathode Fluorescent Lamps are the simplest of the more efficient light sources

Only two terminals per lamp

No moving contacts

One auxiliary gives 24,750 lumens* equal to four 300 watt incandescent lamps

Lamps are the wiring system—no metal channels necessary

Efficient

Colonial Cathode Fluorescent Lamps have an output of 39 plus lumens per watt (including auxiliary loss) putting them in the class of the most efficient light sources

Small diameters mean less trapped light in reflectors. Less area for dirt to collect

Can be mounted efficiently on white ceilings without reflectors

Instantaneous starting—no starting or pre-heating devices used

Economical

Colonial Cold Cathode Fluorescent Lamps use minimum amount of critical materials when used either bare or in fixtures

Lamp-life guaranteed for one year—nothing to replace but lamps

Low temperature permits efficient use of non-metallic reflectors

Can be connected to existing outlets regardless of exact location

Can be operated on 115 volts or 230 or 460 volts, thus increasing quantity of light obtainable from an existing wiring system

* E.T.L. tested

Recessed Lighting Troffers—bare lamps without diffusing glass.

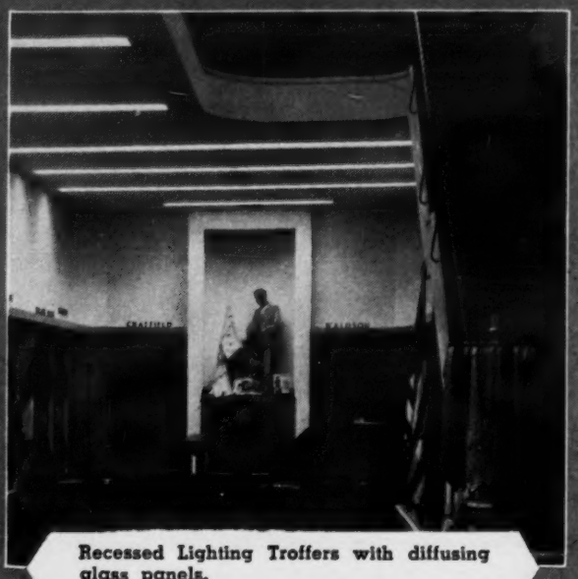
Industrial Hanging Type Reflector.

Our war-time catalog is now available. Jobbers and Distributors inquiries solicited.

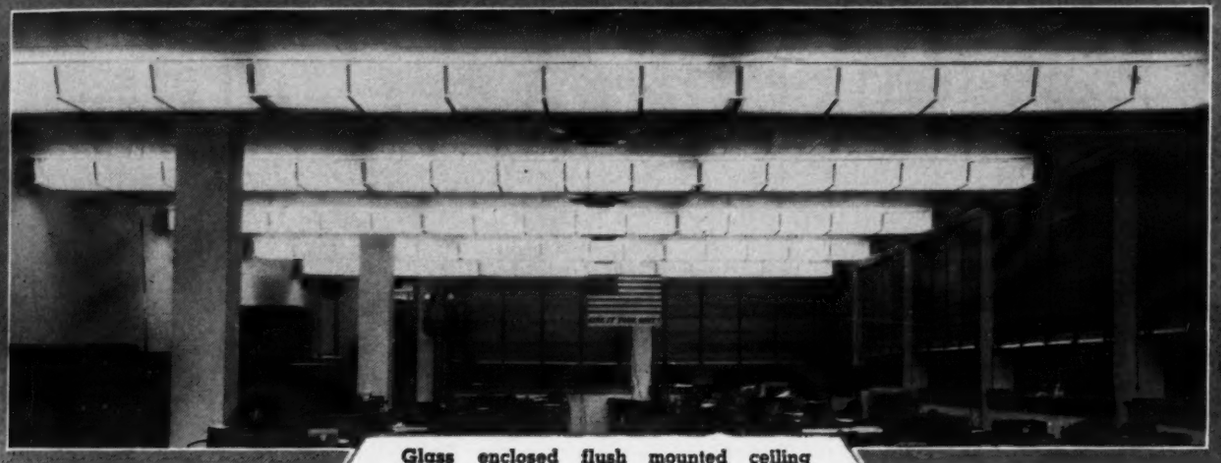
COLONIA

Fluorescent LAMPS

Bare Lamps ceiling mounted for continuous line industrial lighting.



Recessed Lighting Troffers with diffusing glass panels.



Glass enclosed flush mounted ceiling fixtures.

Colonial Fixtures are Underwriters approved and listed. Now available to war industries—

Two and four lamp non-metallic industrial type.
Two and four lamp glass enclosed "Allen Type".
Two, four and six lamp recessed "Troffer Type" with or without diffusing glass.
Bare lamps for ceiling mountings as used by I. T. E.
Send for story of the largest cold cathode industrial installation in the U. S.—a reprint of the I. E. S. paper on the I. T. E. Circuit Breaker Co. installation.

For further information call on your local central station lighting engineer or write to us.

Lighting

DIVISION OF COLONIAL NEON COMPANY, INC.

NORTH BERGEN, N. J.

RELIGHTING PROBLEMS?

DO WE QUALIFY?...
WHAT ARE THE SPECIFICATIONS?..
WHICH MATERIALS ARE AVAILABLE?..
CAN WE GET PERMISSION TO RELIGHT?..
INCANDESCENT OR FLUORESCENT?..
WHAT ARE GOVERNMENT LIMITATIONS?
WHICH FORM OF LIGHTING?..

Consult HOLOPHANE ENGINEERS

Today industrial management must have better illumination—but also must pre sent clear proof to the government that relighting will be of direct help to th war effort. The plan as well as the method of relighting calls for diligent study an professional supervision. Holophane engineers, who have concentrated on th all-important job of specifying practical, efficient illumination for war production offer their knowledge and experience to solve current relighting problems.

HOLOPHANE PRISMATIC GLASS is Uniquely Advantageous for Relighting Under Present Limitations . .

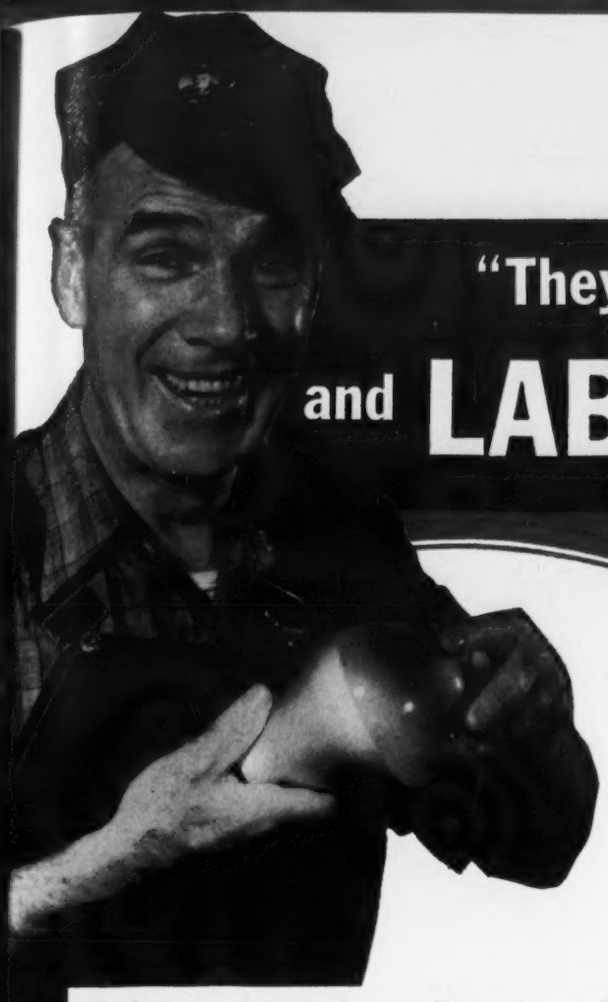
This organization has always employed prismatic glass for its equipment. Th use of glass *is not,* and never was, a substitute measure. This *non-critical* materia is actually the best functional element for light control. Holophane *Planne* Lighting affords savings in fixtures, wattage, and wiring. It provides correct seeing conditions which reduce accidents. It assures operating economies.

Send for "Guide to Relighting in Accordance with Wartime Regulations." It gives all the pertinent facts as to W. P. B. restrictions; also engineering procedure and recommended equipment. Available without charge.

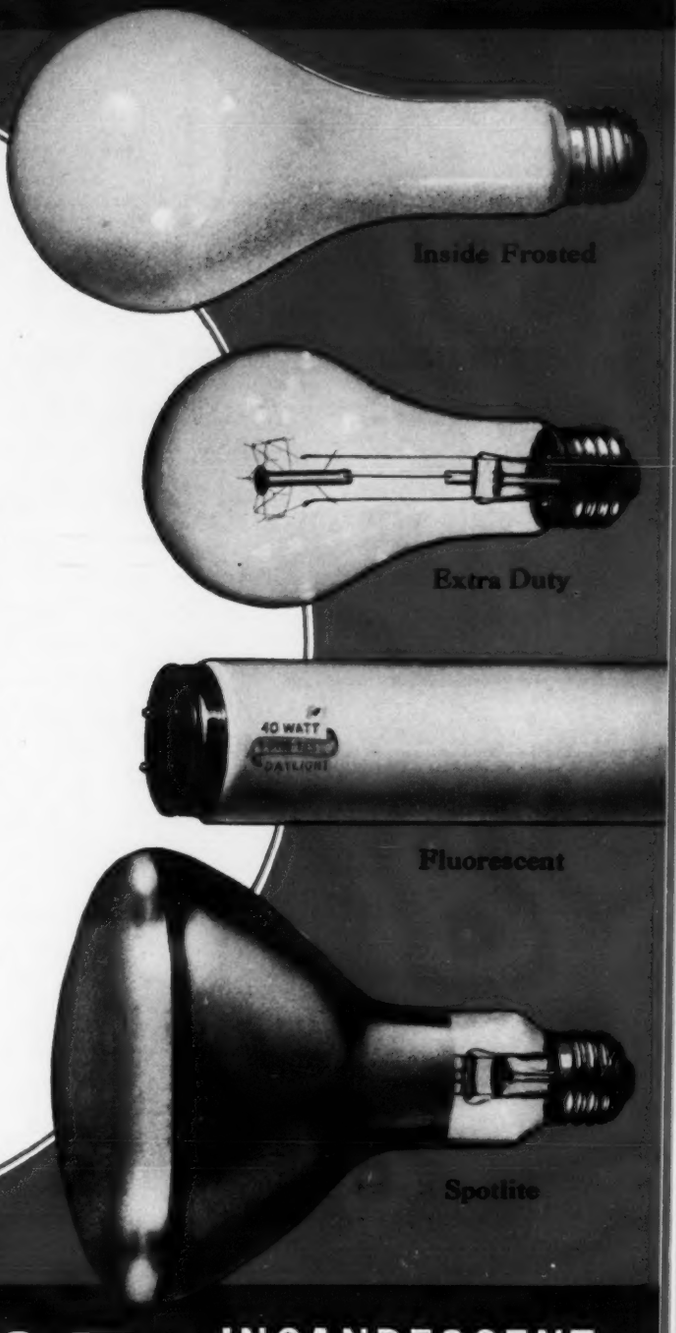
Holophane

HOLOPHANE CO., INC. *LIGHTING AUTHORITIES SINCE 1898*

342 MADISON AVE., NEW YORK HOLOPHANE CO., LTD., 385 YONGE ST., TORONTO, CAN.



"They're Better Lamps — and LABOR SAVERS too!"



By burning longer than ordinary lamps Duro-Test cuts replacements — saves labor — reduces work stoppage.

Duro-Test lamps light the war production lines of many industries. Widespread approval has given Duro-Test the well-earned reputation of being 'America's Industrial Lamp'.

Built to the best precision engineering and manufacturing standards and rated to deliver 2,000 burning hours, Duro-Test lamps are fully backed by a one year free replacement guarantee.

Duro-Test lamps are distributed exclusively through our own specially trained service representatives to help you properly and economically plan your lighting layouts and lamp requirements.

DURO-TEST

INCANDESCENT
FLUORESCENT
ELECTRONIC

Write for complete illustrated catalog to Dept. W

DURO-TEST CORPORATION • NORTH BERGEN, NEW JERSEY

"WAR-AID"

Fluorescent Fixtures *by Wheeler...*

Sturdy metal-conserving wiring channel. Non-metallic reflector with chip-proof washable surfaces. Made for 2 or 3 40-watt lamps, or 2 100-watt lamps. Easily adapted for continuous runs.

- **maintain "skilled lighting" standards**
- **conserve critical materials**

OTHER WHEELER FIXTURES

RLM One-Piece Solid Neck Reflectors

Made in Dome, Angle and all other standard types. For indoor or outdoor use.

Class II-G Dust-Tight Units

Fluorescent fixtures approved for "Class II-G" hazardous locations. Hinged cover protects lamps, sockets and reflecting surfaces. Made for two or three 40-watt lamps.

IT takes accurate "seeing" by workers to maintain today's precision standards of production. In any warplant, that means lighting of the most modern, efficient type.

To make such lighting available *in spite of wartime metal shortages,* Wheeler Reflector Company developed "War-Aid" RLM Fluorescent Fixtures. Made with minimum strategic materials... designed with "know how" gained in over 60 years of specialized experience... "War-Aid" Fixtures offer the same high-efficiency illumination that has always typified Wheeler "Skilled Lighting."

Whether you require fluorescent or incandescent illumination, Wheeler can supply *skilled lighting* for precision production. Write for catalogs of both types. **Wheeler Reflector Co., 275 Congress St., Boston, Mass.** ... New York, Cleveland. Representatives in principal cities.

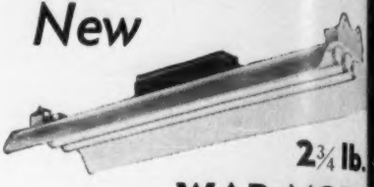
Distributed Exclusively Through Electrical Wholesalers

Wheeler REFLECTOR COMPANY

Lighting Equipment Specialists Since 1881

Rx SIGHT FOR VICTORY

New



2¾ lb.
WAR MODE

Conforms to Latest Steel Limit tions Order

Individual or Continous Row Mounting

Certified Fleur-O-Lier Underwrite Label

Light the way to Victory with

Good Lighting in War Plant

ENABLES PEOPLE TO

See faster
See more accurately
See more easily
See more comfortably

WHICH MEANS

More production in industry
Better working in offices
Greater efficiency in drafti rooms

WHICH ADDS UP

More ships **More tan**
More planes **More guns**

We can help you with your wa time lighting problems:

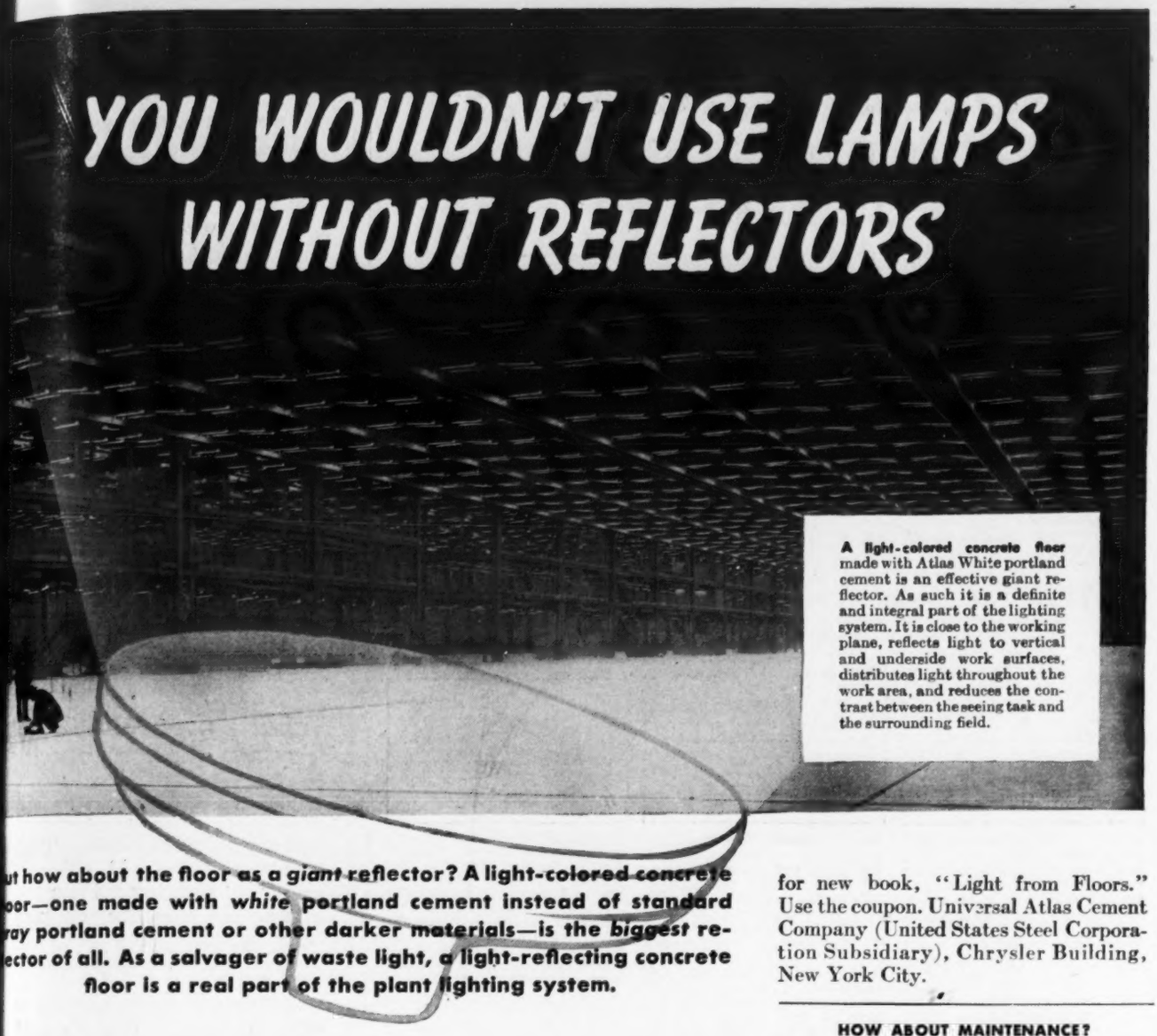
When in New York Visit Our Showroo

Gruber Brother

Fleuroller Manufacturers

72-78 Spring St. New York, N.

YOU WOULDN'T USE LAMPS WITHOUT REFLECTORS



A light-colored concrete floor made with Atlas White portland cement is an effective giant reflector. As such it is a definite and integral part of the lighting system. It is close to the working plane, reflects light to vertical and underside work surfaces, distributes light throughout the work area, and reduces the contrast between the seeing task and the surrounding field.

ut how about the floor as a *giant* reflector? A light-colored concrete oor—one made with *white* portland cement instead of standard ray portland cement or other darker materials—is the *biggest* reector of all. As a salvager of waste light, a light-reflecting concrete floor is a real part of the plant lighting system.

his is shown in aircraft plants built for oeing, Consolidated, Douglas, North merican and others. In the Consolidated stallation at Fort Worth, a lighting rvey by General Electric shows that e concrete floor built with Atlas White ment compared with a gray-cement oor in the same plant—

- *Reflects 20% more light to vertical work surfaces;*
- *Reflects 61% more light to underside surfaces;*
- *Reduces shadows and dark areas;*
- *Reduces the contrast between the seeing task and the floor and thereby enables industry to use increasingly higher levels of illumination with greater effectiveness, efficiency and comfort.*

If the comparison were made between the white-cement floors and still darker floors, the difference would be even greater.

In telling this story to industry we join you in promoting "Better Light, Better Sight." For case histories, diagrams, and installation and maintenance data on light-reflecting floors made with Atlas White portland cement, send for new book, "Light from Floors." Use the coupon. Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York City.

HOW ABOUT MAINTENANCE?

White-cement floors encourage cleanliness. They are light in color, have a minimum of joints to collect dust and dirt, and a relatively non-absorbent surface. Experience in the Consolidated plant shows they are easy to clean, easy to keep clean, and retain their reflection advantage. Maintenance is simple—frequent sweeping, occasional damp mopping, periodic scrubbing.

OFFICES:

New York, Chicago, Des Moines, Philadelphia, Duluth, Albany, Boston, Kansas City, St. Louis, Birmingham, Cleveland, Pittsburgh, Minneapolis, Waco.

ATLAS WHITE CEMENT

FOR LIGHT-REFLECTING FLOORS

Universal Atlas Cement Company, Chrysler Building, New York, N. Y.

Please send me copy of new book, "Light from Floors." EW-F-21

Name_____

Position_____

Company_____

Address_____

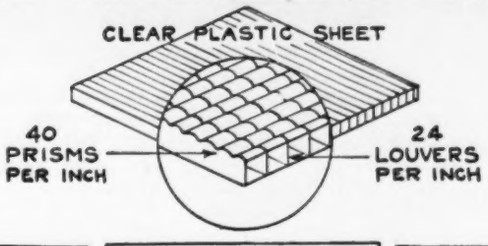
TO *Stop Glare* USE

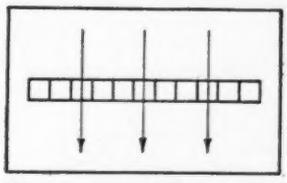
"LOUVERPLAS"

Reg. Trade Mark

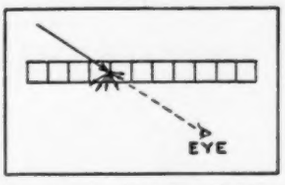
GLARE ZONE SHIELDING!
CONTROL FLUORESCENT LIGHTING
IMPROVE YOUR SEEING EFFICIENCY

USED BY THE ARMY AND NAVY



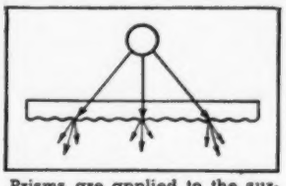


Sheet is composed of clear plastic alternately spaced with thin white translucent or black opaque plastic louvers. The clear plastic has high transparency for light transmission. Light is efficiently directed to the work area where it is required, not into the eyes.



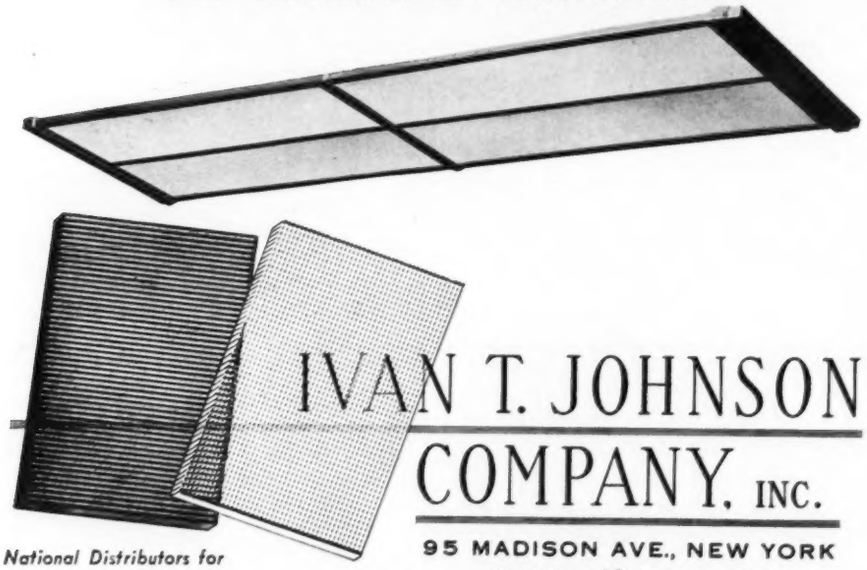
Louvers are the most effective method for the lengthwise control of the fluorescent lamp. As used in the Glare Zone Shield, the thin white translucent louvers diffuse the light within the glare zone that would otherwise enter the eyes as glare.

Black opaque louvers will completely obscure the light source from vision. The degree of light control can be varied by the thickness of the sheet.



Prisms are applied to the surface of Louverplas perpendicular to the louvers. The prisms disperse the light source image and control the light in directions parallel with the clear plastic, lowering the surface brightness and eliminating glare. As used in the Glare Zone Shield, the prisms give efficient sidewise control.

Louverplas Glare Zone Covers for Industrial Reflectors



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95 MADISON AVE., NEW YORK

TELEPHONE ASHLAND 4-4212

THE DOANE PRODUCTS CORPORATION, MERIDEN, CONNECTICUT

NEED INFORMATION on LIGHTING EQUIPMENT?

If you need complete product data on all types of lighting equipment, the 1943 Electrical Buyers Reference will answer questions like these:

Who are the leading manufacturers of lighting fixtures?

(24 of them have condensed catalogs in the front of the book . . . specifications, offices, representatives, etc.)

What products does each manufacturer make?

(Electrical Buyers Reference has a product-classified list of manufacturers — 11 columns under "Lighting Fixtures" alone. In addition, all product classifications are completely indexed and cross-indexed.)

What are the trade names of various lighting equipment?

(A full section is devoted to trade name and company listings.)

Electrical Buyers Reference is a "department store" of lighting equipment . . . it contains the goods of many lighting manufacturers, all grouped together, where they can be reviewed, compared and purchased with the least possible time and effort.

For lighting as well as hundreds of other electrical products, you'll save time in using Electrical Buyers Reference.

ELECTRICAL BUYERS REFERENCE

A McGraw-Hill Reference Service

330 West 42nd St., New York 18, N. Y.

POST-WAR LIGHTING and FLEUR-O-LIERS

★

Whatever else may be said about post-war lighting, one thing is very definite and certain: Fluorescent lighting, with its many potent advantages, is going to have the call in commercial, residential, and industrial fields.

Today, the sale of fixtures for Fluorescent lighting is limited by government and economic restrictions to the service of war production plants.

Tomorrow you can paint for yourself. With limitations removed, there will be a tremendous demand. When peace comes, the significance of the Fleur-O-Lier idea expressed in the following pages will become tremendously important. For the Fleur-O-Lier idea, with its fifty definite Standards of Satisfaction and its approved mechanism for testing, certifying, and guaranteeing all the lighting fixtures bearing the Fleur-O-Lier label, will become even more attractive and valuable as a means of identifying satisfactory fixtures.

The Fleur-O-Lier idea reflects a sound American idea of cooperation for the benefit of the ultimate user. Thirty-five manufacturers of lighting equipment are participating in the movement to make satisfactory Fluorescent fixtures and equipment easy to identify.

Fleur-O-Lier is not a brand name, but a symbol of a vitalizing idea that provides definite minimum standards for the manufacture of satisfactory Fluorescent lighting fixtures. It is not a limiting idea that retards progress, but an unlimited idea that promotes advance in the art of building fixtures for satisfactory service in all fields of Fluorescent lighting.

★ ★

Participation in FLEUR-O-LIER MANUFACTURERS' program is open to any manufacturer who complies with FLEUR-O-LIER requirements.

FLEUR-O-LIER ★ ★ ★ TESTED ★ CERTIFIED ★ GUARANTEED

FLEUR-O-LIER ★★★ TESTED ★ CERTIFIED ★ GUARANTEED

35 manufacturers

Certified
FLEUR-O-LIER
The Manufacturer guarantees by affixing this label that this Fluorescent Luminaire is a duplicate of samples found by periodic examination to comply with the minimum requirements as set up in the
"SPECIFICATIONS FOR LUMINAIRES, FITTINGS AND AUXILIARIES FOR FLUORESCENT LAMPS"
which are sponsored by the Manufacturers of Mazda Lamps.
Electrical Testing Laboratories, Inc.
NEW YORK, N. Y. 8-42
E·T·L
A COPY OF THIS CERTIFICATE SHOULD APPEAR UPON EACH UNIT OR PACKAGE
E·T·L
FLUORESCENT LIGHTING FIXTURES EMPLOYING EXISTING TYPES OF LAMPS ARE NOT RECOMMENDED FOR SCHOOLS, OFFICES AND SIMILAR LOCATIONS UNLESS LAMPS ARE SHIELDED FROM DIRECT VIEW.
THIS CERTIFICATION IS CONTINGENT UPON EMPLOYMENT OF CERTIFIED AUXILIARIES OF OVER 85% POWER FACTOR

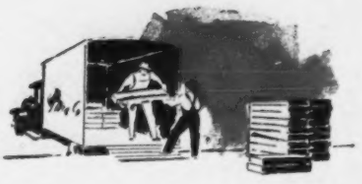
Be sure the fluorescent lighting fixtures you specify wear this label!

hink this is a good way to protect you and your customers

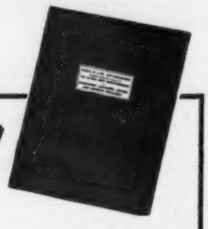
ey thought so in 1938. They still ink so today. Because the Fleur-Lier fixture program then, as w, assures safe, satisfactory ap-ication of fluorescent lighting d protects the maker, supplier d user.

ery single part of a FLEUR-O-ER fixture is tested and CER-IFIED by impartial experts, Elec-ical Testing Laboratories, Inc., of New York, at the beginning. Then, checks are made at quarterly intervals by an E. T. L. inspector who visits the factory of each participant. *Starters* and *ballasts* have their own Certification tests to make sure you get high power factor and reliable operation.

The result? You don't have to test either the whole or any part of a FLEUR-O-LIER over again. The Certification Labels make it unnecessary. That saves time and money for you. Today, FLEUR-O-LIER dependability and easy, low-cost maintenance are proving themselves in a lot of war plants.



FLEUR-O-LIERS conform to all WPB conservation orders. Available only with suitable priority rating. Whenever fluorescent is indicated, be sure to specify fixtures bearing the FLEUR-O-LIER Label.



NEW!

Write NOW! for new booklet containing complete FLEUR-O-LIER engineering specifications. You'll want them for ready reference when you specify lighting equipment. With them you'll get the FLEUR-O-LIER story and list of manufacturers. Address FLEUR-O-LIER MANUFACTURERS, 2126-7 Keith Building, Cleveland 15, Ohio.

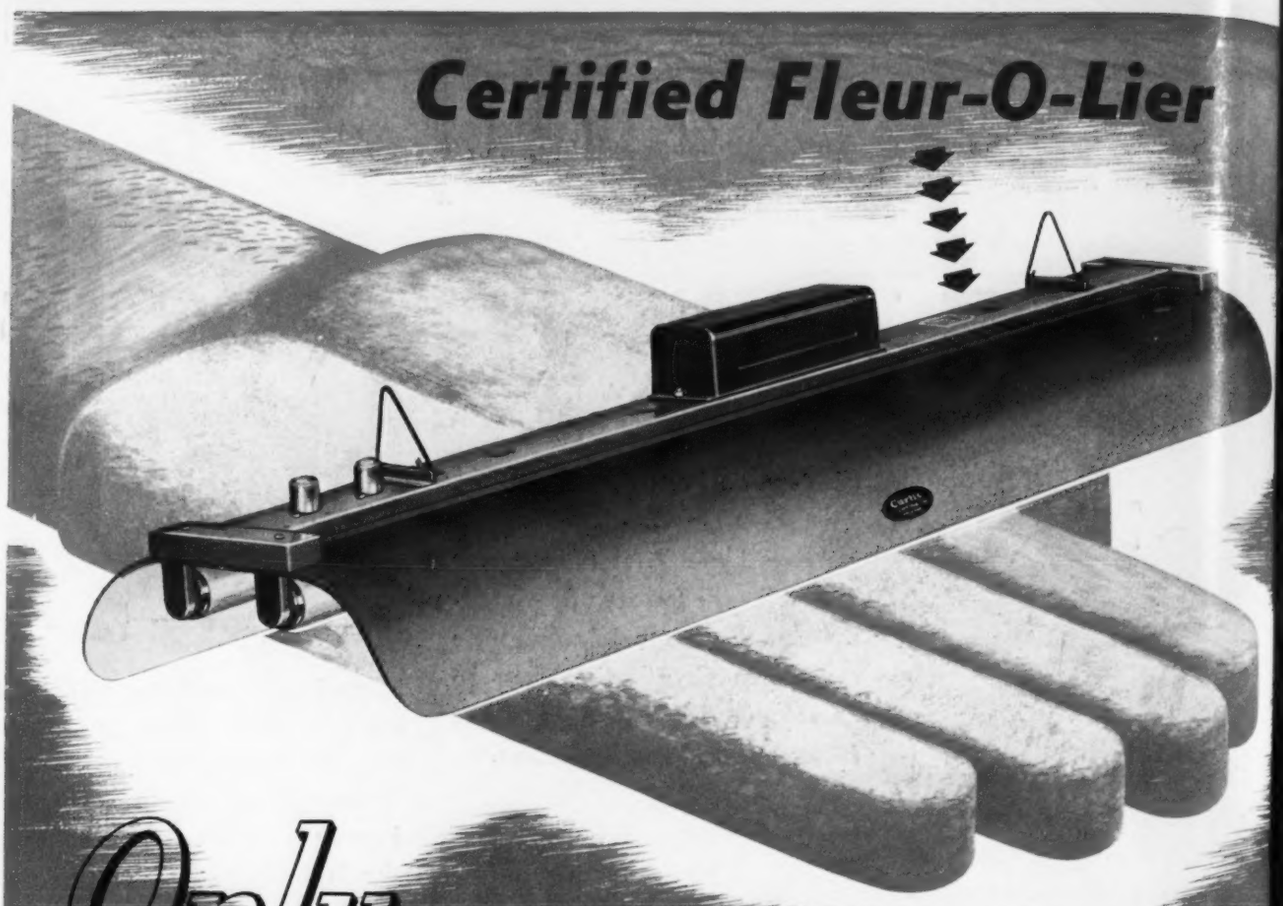
FLEUR-O-LIERS

CERTIFIED FIXTURES FOR FLUORESCENT LIGHTING

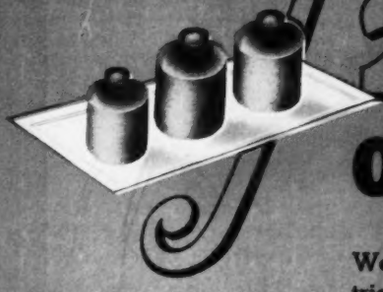
Participation in the FLEUR-O-LIER MANUFACTURERS program is open to any manufacturer who complies with FLEUR-O-LIER requirements

FLEUR-O-LIER ★ ★ ★ TESTED ★ CERTIFIED ★ GUARANTEED

FLEUR-O-LIER ★ ★ ★ TESTED ★ CERTIFIED ★ GUARANTEED



Only 2½ POUNDS Of Metal in the Wireway



Well under the three-pound steel limitation, this neat new Curtis Industrial Lighting Unit has a wiring channel weighing approximately 2½ pounds—a compact fluorescent unit for two or three 40-watt lamps.

The unit illustrated is Cat. No. 1606-C, individual unit for 2—40-watt lamps. Also available in this new design are units for 3—40-watt lamps, 5 foot units for 2—100-watt lamps, and units for installation in continuous lines with either 40-watt or 100-watt lamps.

To provide flexibility in hanging, the shallow wireway is so shaped that it can be supported by movable clamps anywhere along the channel between the ballast and the sockets.

Best of all, the new design has Curtis "Fluratex" non-metallic reflectors with the famous high efficiency *Fluracite* reflecting surface.

You need complete information on this new unit. Send for it direct to us, or to the Curtis representative near you.

Conforms to Latest Steel Limitations Order

Compact, Simplified

Underwriters Label

Individual or Continuous Row Mounting

Certified Fleur-O-Lier

CURTIS LIGHTING, INC.

6135 WEST 65TH STREET, CHICAGO, ILLINOIS

HOW MANY FOOTCANDLES *back of a bomber?*

★ How many footcandles to roll the armor? How many to build the bombsight? How many to machine the guns? How many footcandles, down on the runway, to bring a homing Fortress safely in?

★ How many footcandles . . . after Victory . . . to light a window for a soldier's swift return?

★ How many footcandles . . . then . . . for your helicopter cockpit? How many for a showcase full of steaks? How many footcandles for a schoolroom where youngsters will read how Berlin fell?

oday, when good lighting is so vital a Victory tool . . . and morrow, when even better lighting will be part and parcel a better way of life . . . GRAYBAR Lighting Specialists and hting products will work for you to provide the answer.

If you have a problem that begins . . . or ends . . . at the *eye-vel*, why not put it up to GRAYBAR?

258
GRAYBAR MEN
have signed this
Bomber Builder pledge:

"I shall make it my daily job to see that lighting is being properly used to help win the war. Also, I shall keep in mind the need for making the minimum of changes and the minimum use of critical materials."

The 507 jobs these men have handled since last September have brought more productive lighting to some 276,000 war workers.

By conservative estimate, the improved seeing has increased productivity to equal 16,560,000 man-hours per year.

GraybaR

IN OVER 80 PRINCIPAL CITIES

Executive Offices: **GRAYBAR BUILDING, NEW YORK, N. Y.**

GRAYBAR QUALITY SINCE 1869 *REG. U.S. PAT. OFF.

Everything Electrical . . . . THAT IT TAKES TO WIN!

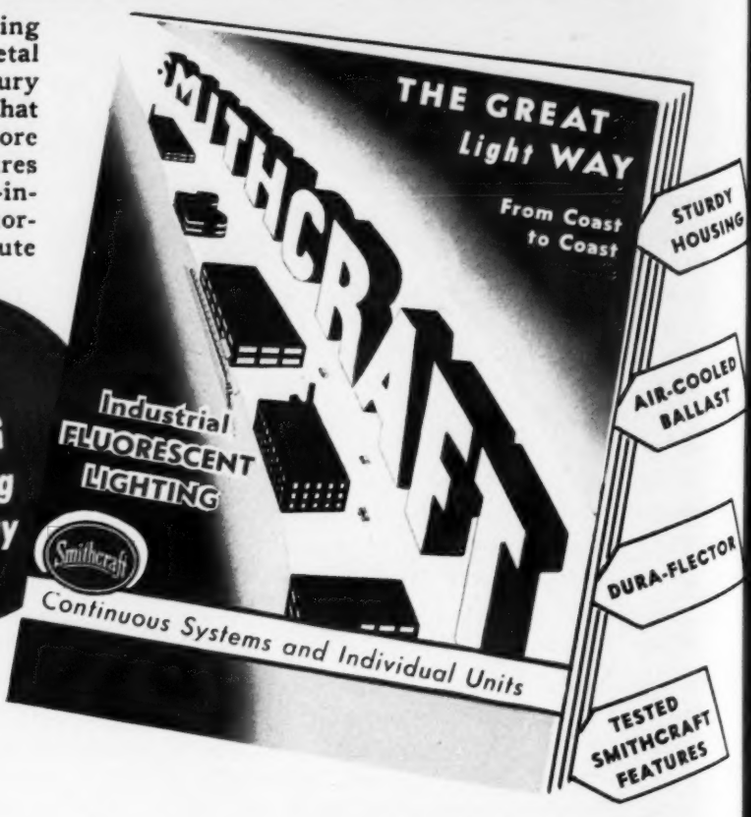
FLEUR-O-LIER ★ ★ ★ TESTED ★ CERTIFIED ★ GUARANTEE

FLEUR-O-LIER ★★★ TESTED ★ CERTIFIED ★ GUARANTEED

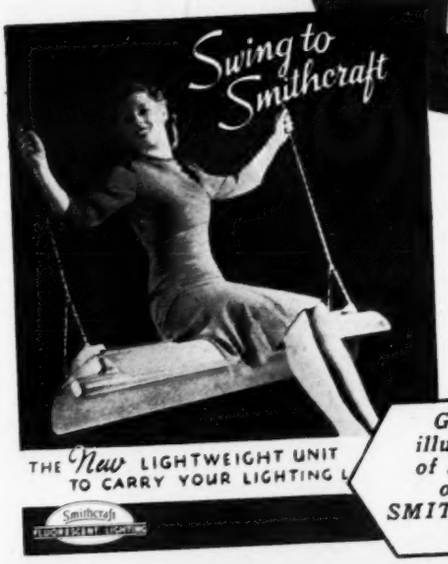
Backed by more than 50 Years of Craftsmanship

The "know how" and sound engineering which has made Smithcraft famous in metal fabrication for more than half a century enables us to build fluorescent fixtures that are mechanically right and deliver more light* . . . the kind of fluorescent fixtures manufacturers are demanding in ever-increasing quantities. Remember — in fluorescent lighting, also, there is no substitute for craftsmanship.

*By actual certified tests.



Send for New CATALOG and Striking Display Card



Graphic illustration of strength of new SMITHCRAFT unit.

This new catalog is chock full of photographs, drawings, and valuable information about Smithcraft individual units and specially designed continuous systems. Yours for the asking.

AND be sure to get your copy of this attractive display card. It is brand new, of convenient size (10" x 13") and beautifully reproduced. Yours without charge if you write now.

A. L. SMITH IRON CO., Chelsea, Mass.

Another Example of GROUP TESTING as an aid to MANUFACTURE AND SALE*

SCOPE of HELPS to M'F'R'S

Testing is supplied to industry in the form of GROUP TESTS (see opposite)

To individual manufacturers, the services at ETL encompass research (vital in post-war plans) . . . determining causes for failure of parts in manufacture or use . . . checking uniformity of raw materials, factory processes, . . . establishing the competitive position of finished products . . . aiding the large manufacturer by supplementing his research laboratory . . . the small manufacturer by serving as his laboratory . . . neither paying overhead when the test service is not in use . . . all work involving electrical, mechanical or chemical tests . . .

Consider ETL experience and facilities an addition to your own plant.

Certified FLEUR-O-LIER fixtures meet 50 definite standards set up by MAZDA lamp manufacturers to assure dependable performance.

Some of the most important specifications checked by Electrical Testing Laboratories, Inc. are: High power factor, flicker correction, certified ballasts and starters, brightness control, safety, maximum light output, correct heat dissipation and many others.

FLEUR - O - LIERS are easily recognizable by the Certification label shown on every fixture. Make sure this label is on the fixtures you specify to assure dependable lighting performance and operation.

Electrical Testing Laboratories, Inc.

HEADQUARTERS AND LABORATORIES
2 EAST END AVENUE AT 79TH STREET · NEW YORK
BUTTERFIELD 8-2600

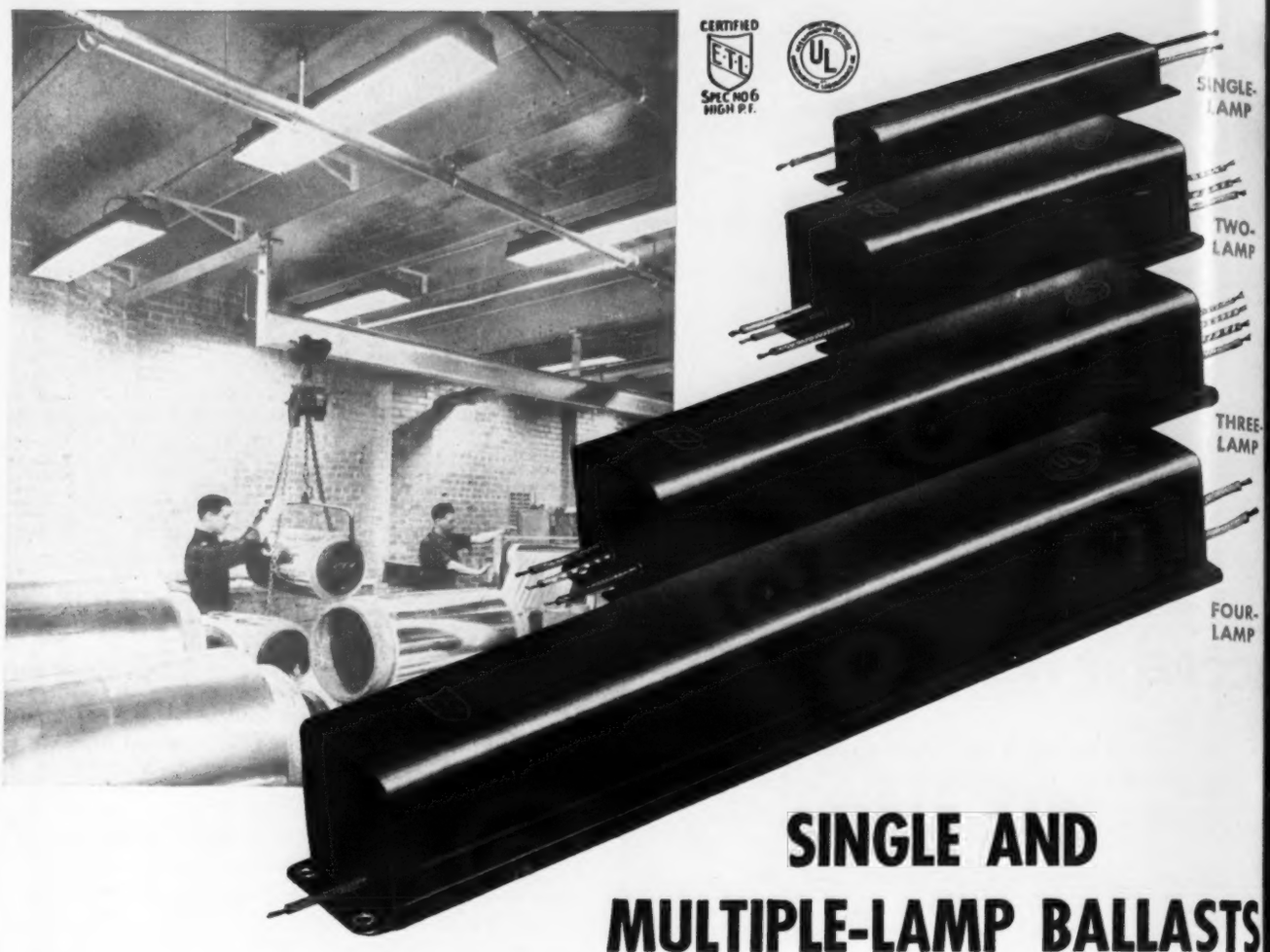
EQUIPMENT: More than three thousand pieces of testing apparatus on inventory.

STAFF: More than 150, experienced in test procedure.

ELECTRICAL AND GENERAL TESTING · INSPECTIONS · RESEARCH CERTIFICATION

FLEUR-O-LIER ★ ★ ★ TESTED ★ CERTIFIED ★ GUARANTEED

FLEUR-O-LIER ★ ★ ★ TESTED ★ CERTIFIED ★ GUARANTEED



SINGLE AND MULTIPLE-LAMP BALLASTS

● Practically every fluorescent lamp installed today is providing illumination to assist in the production of badly needed planes, machines, tanks, engines,—combat equipment and war materiel of every kind. The satisfactory operation of these fluorescent lamps is essential, and this hinges to a great extent on the performance of one piece of equipment,—the Ballast.

At Jefferson Electric, the importance of the Ballast is well recognized,—and design, selection of all materials, construction and expert craftsmanship all contribute to the reliability for which transformers and ballasts bearing the Jefferson Electric mark have long been known.

Save Critical Metals with Multi-Lamp Ballasts

Where groups of fluorescent lamps are installed, great savings in copper and other metals are possible by using Multi-Lamp type Ballasts. Costs are cut and installation time reduced. Four 100-watt lamps, for example, served by one Four-lamp Ballast saves 50 per cent of the cold rolled steel, silicon, and copper required for *two* two-lamp 100-watt Ballasts. Too, power losses are reduced, and since four-lamp Ballasts may be used on 250-280 volt circuits, conductors can be smaller than for 110-130 volt circuits, another saving of copper.

Write for Bulletin 421-FL which carries full data. Recommendations of our engineers are yours for the asking . . . JEFFERSON ELECTRIC COMPANY, Bellwood, (Suburb of Chicago) Illinois. *Canadian Factory:* 60-64 Osler Avenue, West Toronto, Ontario.

JEFFERSON ELECTRIC

FLUORESCENT LAMP BALLASTS

HOW TO CUT LIGHTING MAINTENANCE TIME

The "Watch Dog," newest in the G-E line of fluorescent lamp starters, does not have to be removed every time a dead lamp is replaced—it remains in the fixture, ready to start the new lamp. This reduces the time spent in lighting maintenance. Further, it permits immediate replacement of dead lamps because no "cooling" period is required.

What's more, the "Watch Dog" is a precision lamp starter and a dead lamp stopper that ends blinking and flickering. Precision starting adds greatly to lamp life because it uses a minimum of emission material so vital to long lamp life.

FOR ADDITIONAL DATA SEND THE COUPON BELOW

Section G732-9
Appliance and Merchandise Dept.
General Electric Company
Bridgeport, Conn.

Gentlemen: Please send me additional information about your new FS-40 "Watch Dog" Starter.

Name .....

Company .....

Address .....

City ..... State .....

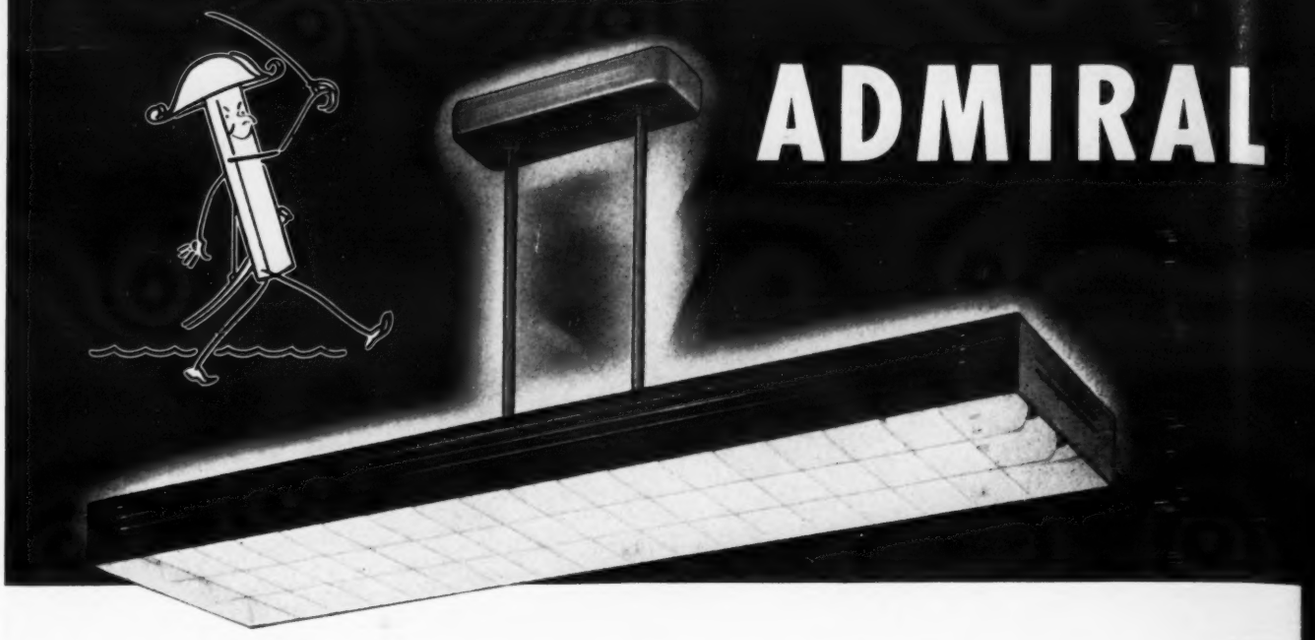
GENERAL ELECTRIC

FLEUR-O-LIER ★ ★ ★ TESTED ★ CERTIFIED ★ GUARANTEED

FLEUR-O-LIER ★★★ TESTED ★ CERTIFIED ★ GUARANTEED

"TOPS" to see by... and it SAVES STEEL

The WAKEFIELD ADMIRAL



Especially adapted for war plant office and drafting room★

MADE largely of wood, the ADMIRAL is designed to provide efficient fluorescent lighting as well as to conserve war materials. It gives diffused, high intensity lighting that helps office people handle essential paper work faster; helps keep them at top efficiency longer, with less eye-strain and fatigue.

Because it puts 90% of its light *down*, the ADMIRAL is especially adapted for work that involves critical seeing or for areas with poor ceilings. And it saves almost enough steel on each four-lamp unit to make a 30-calibre machine gun!

Perhaps the ADMIRAL can help you speed war production for your customers by speeding their paper work. Comes in two, three and four lamp units and can be interconnected on special order. Write for details.

★IMPORTANT NOTE: At present the ADMIRAL is available only on lighting projects specifically approved by the Lighting and Fixtures Section of WPB and the Director of Industrial Operations. Such approval might be given if high intensity lighting were required on work essential to the war effort which also has the possibility of eliminating re-wiring or materially saving copper and conduit.

For outstanding war production . . . made possible through the untiring efforts of our men and women in producing equipment which has helped save fighting ships and fighting men.

ARMY E NAVY

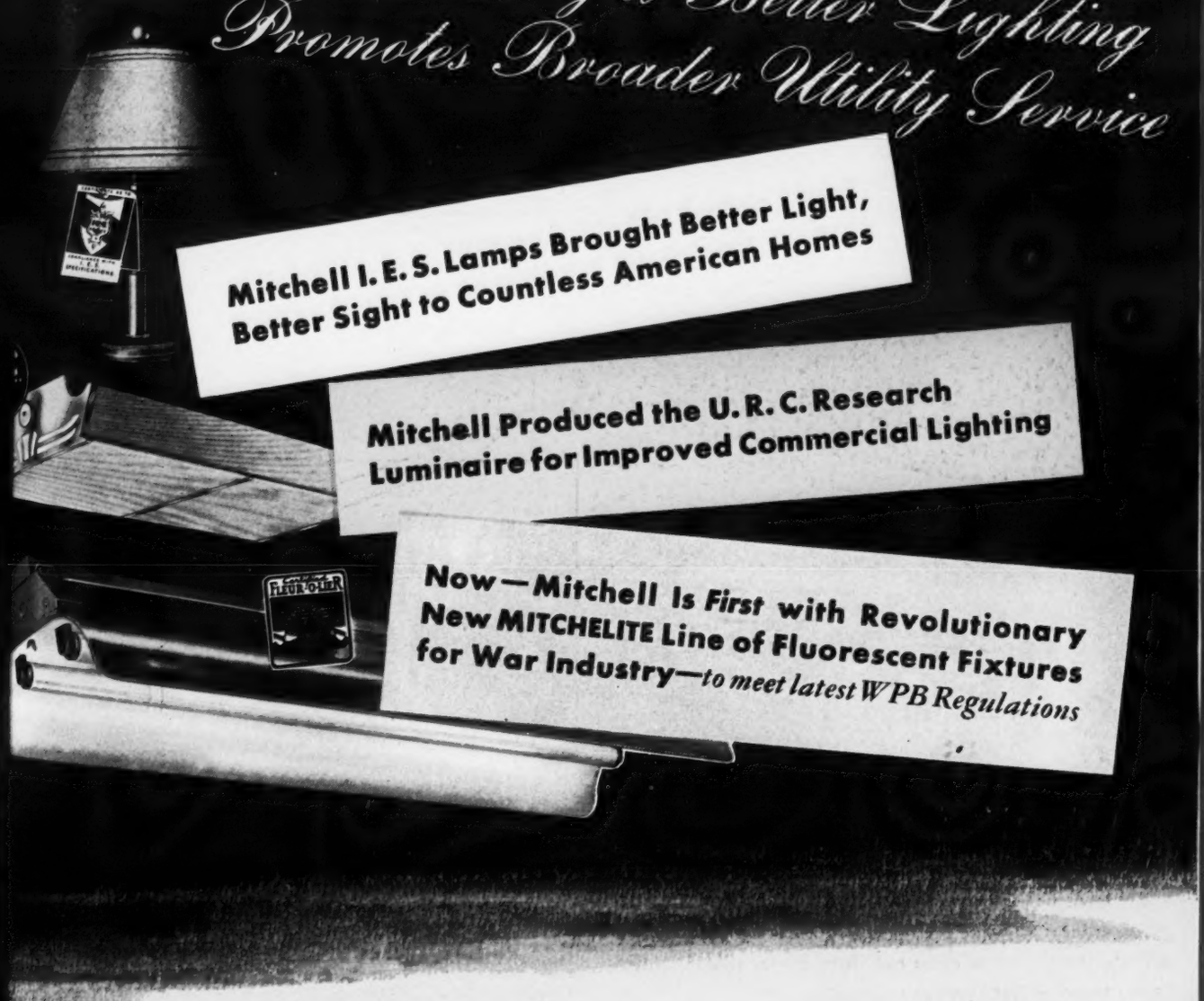
THE F. W. **Wakefield** BRASS COMPANY

RED SPOT LIGHTING FOR COMBAT OPERATIONS AND WAR PRODUCTION

VERMILION, OHIO

MITCHELL

Leads the Way to Better Lighting
Promotes Broader Utility Service



Mitchell I. E. S. Lamps Brought Better Light, Better Sight to Countless American Homes

Mitchell Produced the U. R. C. Research Luminaire for Improved Commercial Lighting

Now—Mitchell Is *First* with Revolutionary New MITCHELITE Line of Fluorescent Fixtures for War Industry—*to meet latest WPB Regulations*

AGAIN and again . . . Mitchell has set the pace in the creation of new units for "Better Light, Better Sight." Yesterday, it was the well-known Mitchell I.E.S. Floor and Table Lamps for the home . . . and the sensational U.R.C. Research Luminaire for commercial use. Today, it's the new revolutionary MITCHELITE Line of Fluorescent Fixtures (Fleur-o-Lier Approved) for war industry. This simpler, more flexible, more economical lightweight unit was another Mitchell first! ALL OVER AMERICA . . . in the homes . . . in stores, offices and institutions . . . in war industries, Mitchell units are helping to light the way to Victory.

For Post-War Load Recovery

Just as in the past, when Mitchell innovations extended the use of electric current for greater lighting efficiency—so, when the rays of peace break through the clouds of war, will Mitchell ingenuity again be ready with new advanced lighting units to render greater public service than ever before.

MITCHELL *Manufacturing Co.*
2525 Clybourn Ave., Chicago, Ill.

MITCHELL

FLEUR-O-LIER ★ ★ ★ TESTED ★ CERTIFIED ★ GUARANTEED

FLEUR-O-LIER ★★★ TESTED ★ CERTIFIED ★ GUARANTEED

BALLASTS WITH LEADS OUT the BOTTOM

They save pounds of critical material per fluorescent fixture

AS AN aid to fixture manufacturers in their programs to save critical materials, we now offer this addition to our line of war-plant ballasts. These ballasts differ from those of conventional design *only* in location of leads, which come out through two bushed holes in the base plate (one at each end).

Installation simplified. These new ballasts can be mounted completely exposed atop a narrow, shallow wiring channel just wide enough and deep enough to enclose the leads. The saving in iron and steel is therefore substantial, since there is no longer need to allow room for the complete ballast in the fixture itself.

Because of their exposed location, these ballasts will operate in lower ambient temperatures—which contributes to long ballast life. They do not require special installation features, such as ventilating louvers and conduction plates.

Wide range of ratings. Ballasts with leads out the bottom are available in 40-watt Tulamp and three-lamp ratings, 100-watt Tulamp and Forlamp ratings—those used most in war plants.

For more details about this improved design, and for information on the rest of the G-E line of ballasts for fluorescent lighting, send for your copy of Bulletin GEA-3293. *General Electric, Schenectady, N. Y.*

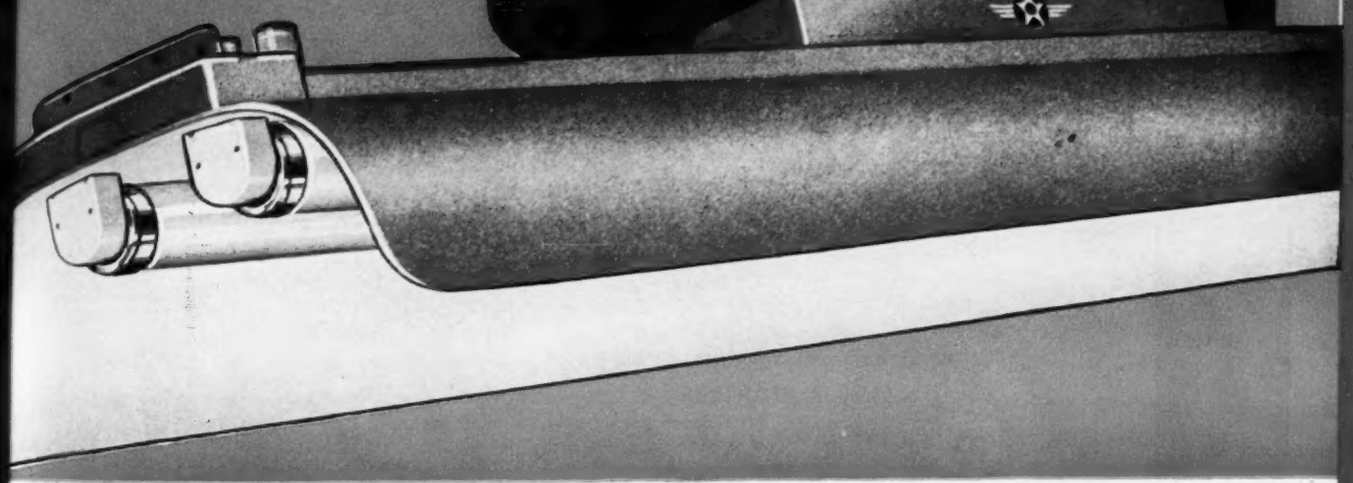
GENERAL ELECTRIC

A NEW

Electro ENGINEERING TRIUMPH!

FLUOR-O-MASTER PRODUCTS

THE METAL-SAVING *Fluor-O-Master* BOMBER



AN BE COUPLED FOR CONTINUOUS
OW INSTALLATION.
ALLASTS ARE AIR-COOLED.
ARTERS EASILY ACCESSIBLE.
URDY HANGERS, NUMEROUS KNOCKOUTS MAKE POSSIBLE ALL TYPES SUSPENSION.

- REFLECTOR MAY BE QUICKLY DROPPED TO EXPOSE WIREWAY FOR SERVICING.
- U. L. APPROVED.

only $2\frac{1}{4}$ POUNDS OF METAL IN MODELS FOR 40-WATT LAMPS ☆ only $3\frac{1}{4}$ POUNDS OF METAL IN MODELS FOR 100-WATT LAMPS

LECTRO MANUFACTURING COMPANY

2000 WEST FULTON STREET • CHICAGO

FLEUR-O-LIER ★ ★ ★ TESTED ★ CERTIFIED ★ GUARANTEED

FLEUR-O-LIER ★ ★ ★ TESTED ★ CERTIFIED ★ GUARANTEED

Perfect Performance

Lloyd Fluorescent Products

Each Lloyd unit is engineered for perfect fluorescent lighting service. Starters, starter sockets and lamp holders which set new standards of efficiency. They are specified repeatedly as the standard of quality and performance. Always specify Lloyd.

LLOYD STARTERS
Perfection in quick starting . . . in longer life . . . in service.

LLOYD STARTER SOCKETS
With the famous "Lobster Claw" Dual Lock Contact. Patented.

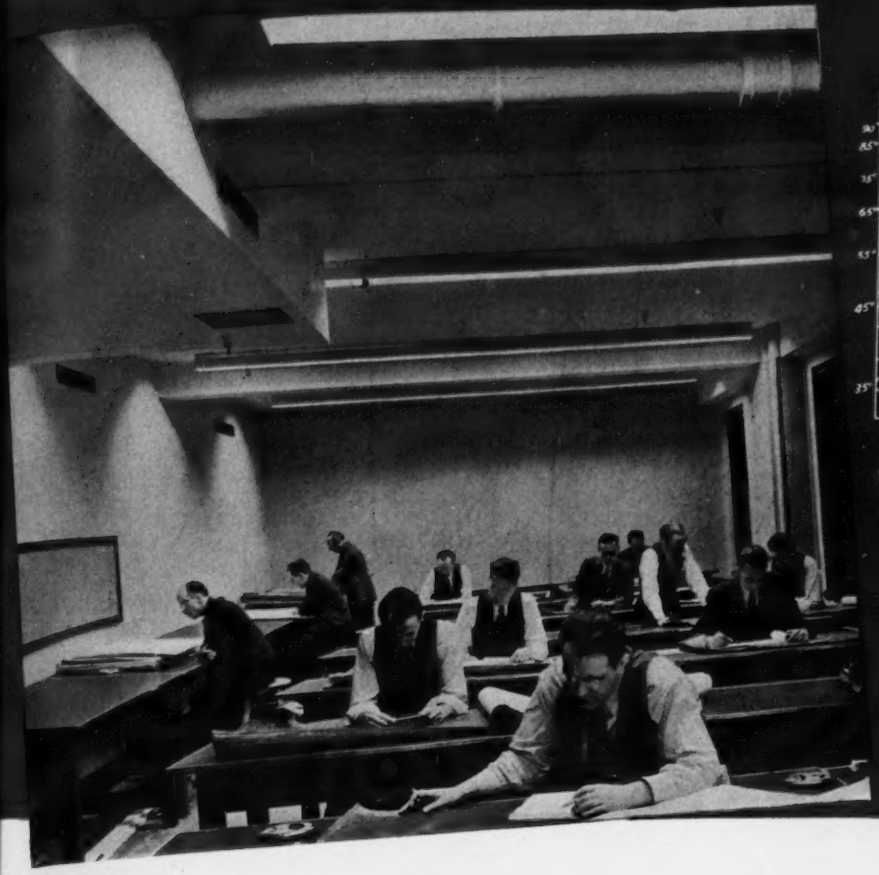
LLOYD TWIST TYPE LAMP HOLDERS
Absolutely simple. Absolutely foolproof. Absolutely secure. Patented.

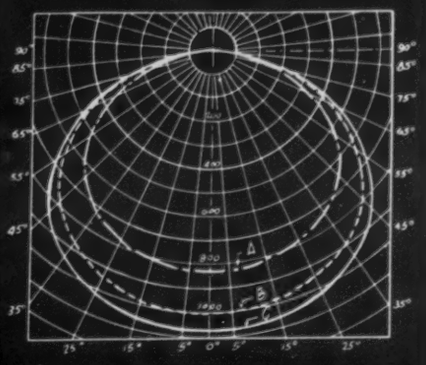
LLOYD POLICY INSURES QUALITY

LLOYD PRODUCTS COMPANY
PROVIDENCE, R. I.
Representatives — Branch Offices — Warehouse Stocks in 23 Leading Cities

Dirt wastes light

Clean reflectors help you maintain high production, reduce errors and accidents





Typical Reflector Light-Distribution Curves
A-Dirty B-Dry-wiped C-Washed

Clean, white walls and Alzak Aluminum Reflectors make it easier to maintain high working efficiency

A dirty surface absorbs a lot of light, whether it's the ceiling, lighting fixture or reflector itself. A regular cleaning program pays excellent dividends. Because better light means better sight, your production program is maintained at higher rates, accidents and errors are reduced.

Your Alzak* Aluminum reflectors were designed by their manufacturers to do a specific task, putting the kind of light you want right where you want it. They employed aluminum with an Alzak finish to assure that those reflectors could keep on doing that job well, with a minimum of attention. Their surface is glass-like, to which dirt does not readily cling. It won't scratch easily or chip.

In some locations, your Alzak Aluminum reflectors may only need an occasional wiping off with a soft, dry cloth to keep them working at high efficiency. Out of doors, or in the presence of dust and fumes, they may require washing with mild soap and water at regular intervals. Under more severe conditions, a more drastic cleaning method may be necessary.

How to maintain Alzak Aluminum reflectors is told in the booklet, "Instructions for the Protection and Maintenance of Alumilite Finishes and Alzak Reflectors." For a copy, write ALUMINUM COMPANY OF AMERICA, 2138 Gulf Building, Pittsburgh, Pennsylvania.

*Registered trade-mark, Aluminum Company of America

ALCOA ALUMINUM

"-more planes than al

Speed on Sub-Assembly

At every step in plane production, from plans to final "gas and go," "See-ability," through better lighting, helps save time and materials.

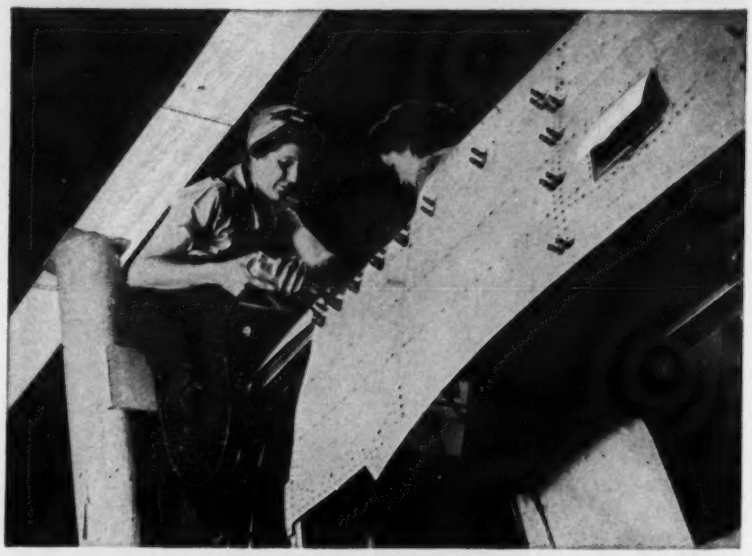
al the rest of the world"

"SEE-ABILITY" helps make them in the world's best-lighted plants

ODAY, the speed of the nation's aircraft pro- uction is amazing even ourselves. In this fort, "See-ability" is playing an important art. For through better lighting, men and omen are working to closer limits, working ith less fatigue, turning out better planes ster. All this calls for millions of Westing- ouse Mazda Lamps, cuts deeper into the na- on's supplies of nickel, copper, tungsten. hat is why in our advertising we are asking sers of lamps to conserve—to get the utmost "See-ability" from their present equipment.

• • •

ew high standards of industrial lighting are eing established today, in many of our war ctories. And today, our job is to supply the mps these factories require. Tomorrow, hen materials are again available, these new andards will set the pace for all industrial ghting. Even greater opportunities, therefore, wait every man in the lighting industry. Vestinghouse Electric and Manufacturing ompany, Lamp Division, Bloomfield, N. J.



Westinghouse

MAZDA LAMPS

FOR GREATER "SEE-ABILITY"

RE-LIGHTING
the new manpower / production *requirement*

HERE'S ONE ANSWER *to this problem...*

This new folder tells the whole story. Send for it!

Because most plants operating today were designed for peacetime, *daylight* working schedules, *their lighting equipment is inadequate for night work!*

The folder illustrated gives one answer to industry's problem of *re-lighting*. Silv-A-King's new fluorescent reflectors of non-critical, metal-saving Silv-A-Tex are durable, efficient, inexpensive, and available for prompt delivery. For complete descriptions and specifications of Silv-A-King "Victory" units, write for a copy of "Catalog 43-V" today!

UL RLM

SILV-A-KING
MAKES *Light* WORK FOR YOU

BRIGHT LIGHT REFLECTOR COMPANY, INC.
1035 Metropolitan Avenue, Brooklyn, N. Y.

BROILKING AFTER THE WAR, MORE THAN EVER *America's Finest Electric Table Broiler*
INTERNATIONAL APPLIANCE CORPORATION
1027 Metropolitan Avenue, Brooklyn, N. Y.

How to design, install, and service fluorescent-lighting systems

MAKE SURE

you get the extra profits promised by the growing popularity of fluorescent lighting. Here is a practical manual covering the subject in all its aspects, presented so that anyone can understand it, with or without much electrical training. Gives the most authoritative information available on construction and performance of all types of fluorescent lamps, principles and methods of calculating illuminating requirements and designing luminaires and installations, pointers and methods of installing and maintaining fluorescent lamps and of locating and remedying their troubles. Includes working data, comparison of cost factors of fluorescent and incandescent lighting, etc.—everything a.d in the designing, selling, installing, and servicing of efficient and satisfactory, fluorescent-lighting systems.

FLUORESCENT LIGHTING MANUAL

By CHARLES L. AMICK
Nela Park Engineering Dept.,
General Electric Company

312 pages, 6x9, 217 illustrations many tables. $3.00

CHAPTERS

1. The Fluorescent Lamp
2. Auxiliary Equipment
3. Operating Characteristics
4. Installation Hints
5. Service Suggestions
6. Luminaire Selection
7. Fluorescent-lighting Design
8. Color Quality
9. Fluorescent Applications
10. Lighting Economics

Besides giving a how-to-do-it cast to all information presented, the author emphasizes its meaning from the standpoint of answering doubts or questions regarding the value of using fluorescent lighting. From this book both newcomers in the lighting industry and more experienced readers will get an overall picture of every link in the fluorescent lighting chain and an appreciation of the importance of each as well as instructions in the methods of design, installation, and servicing.

10 DAYS' FREE EXAMINATION

McGraw-Hill Book Co., 330 W. 42nd St., N. Y. 18.
Send me Amick—Fluorescent Lighting Manual for 10 days' examination on approval. In 10 days I will send $3.00 plus few cents postage or return book postpaid. (We pay postage if you remit with order.)

Name .....
Address .....
City and State .....
Position .....
Company ..... FEW 7-10-43

Here's PRODUCT DATA on all types of LIGHTING EQUIPMENT!

592 PAGES of reference and catalog data make the 1943 Electrical Buyers Reference the most valuable book in your office. It's a closetful of catalogs in one handy, thoroughly indexed volume.

If you want complete lighting data, here's how Electrical Buyers Reference helps:

FIRST: 24 leading manufacturers of lighting fixtures have condensed catalogs in the front of the book . . . specifications, offices, representatives, etc.

SECOND: there's a product-classified list of manufacturers—11 columns under "Lighting Fixtures" alone.

THIRD: The product classifications are completely indexed and cross-indexed; and . . .

FOURTH: a full section is devoted to trade name and company listings.

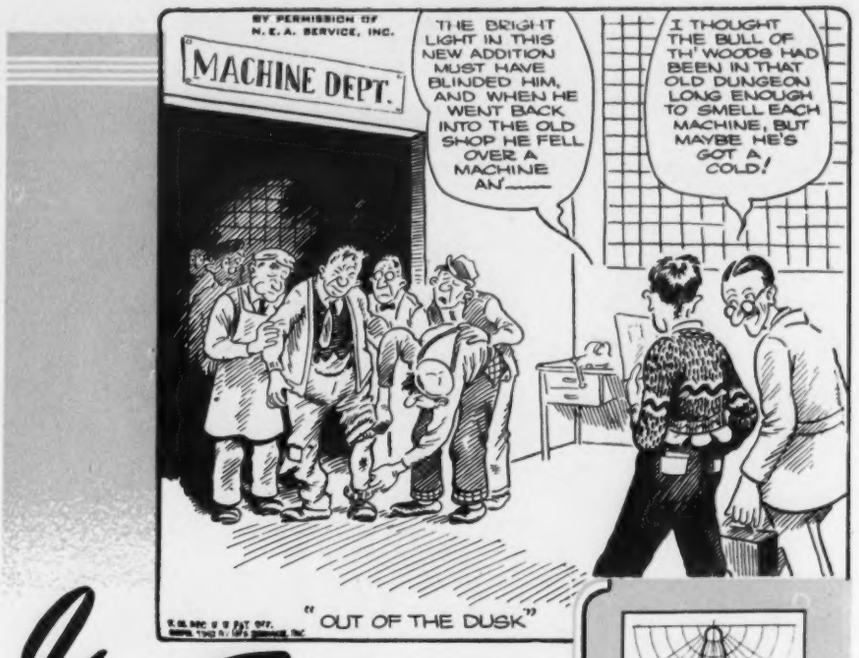
Electrical Buyers Reference has a wealth of information you need on lighting—and on hundreds of other products.

During these extra-busy days you'll find Electrical Buyers Reference a real time saver!

ELECTRICAL BUYERS REFERENCE

A McGraw-Hill Reference Service

330 West 42nd Street, New York, N. Y.

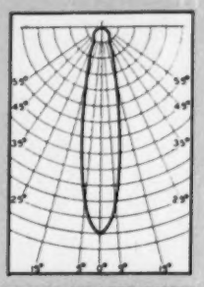

BY PERMISSION OF N. E. A. SERVICE, INC.
MACHINE DEPT.
THE BRIGHT LIGHT IN THIS NEW ADDITION MUST HAVE BLINDED HIM, AND WHEN HE WENT BACK INTO THE OLD SHOP HE FELL OVER A MACHINE AN'——
I THOUGHT THE BULL OF TH' WOODS HAD BEEN IN THAT OLD DUNGEON LONG ENOUGH TO SMELL EACH MACHINE, BUT MAYBE HE'S GOT A COLD!
"OUT OF THE DUSK"

Your Production IS DIRECTLY RELATED TO *Your Lighting!*

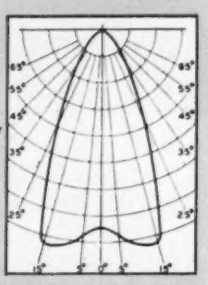
Workers work quicker when they see Better, workers work better when they see Quicker! Light is a production tool. Employ it efficiently, economically by the aid of Permaflectors – the "shaped mirrors" of silvered glass that direct light to where you need and want it

THE RIGHT LIGHT ON THE WORK FROM 6 OR 60 FEET AWAY

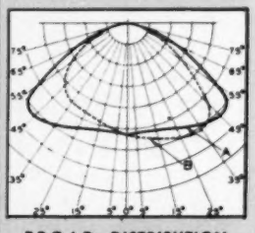
There is a Permaflector unit for every lighting problem – to provide accurate, controlled light, efficiently – no matter what your mounting requirements may be. Permaflectors are easily, inexpensively installed. Require a minimum of maintenance.



CONCENTRATED DISTRIBUTION Permaflectors for high mountings—from 25' to 60'.



MEDIUM DISTRIBUTION Permaflectors for mountings of from 15' to 25'



BROAD DISTRIBUTION Permaflectors for "horizon" mounting, 15' or less from floor.

PITTSBURGH REFLECTOR CO.

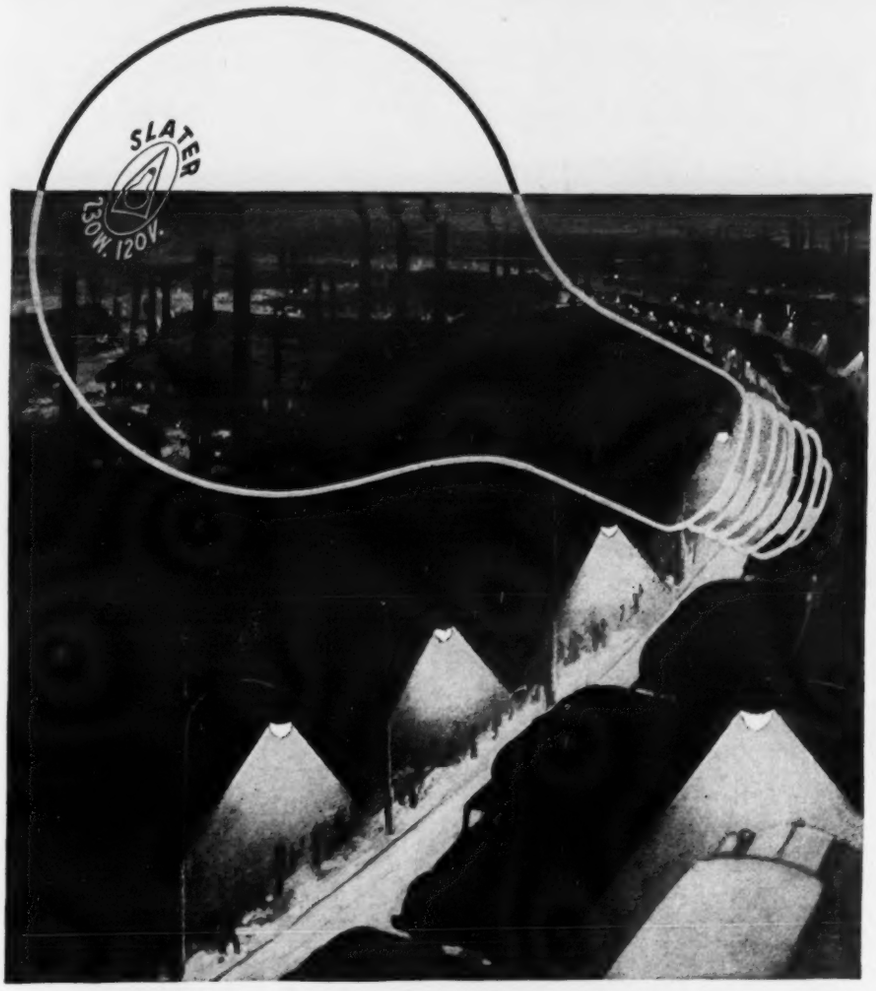
OLIVER BLDG. PITTSBURGH, PA.

Please rush complete data on Permaflector Industrial Lighting Units. EW 7-43

NAME.....

ADDRESS.....

CITY.....STATE.....



LIGHT PROTECTION
for NIGHT PRODUCTION

In the black of night . . . machines humming in thousands of war plants . . . night shifts coming and going . . . trucks trundling along to deliver war materials. This is America's battle of production, night after night.

And on these busy traffic channels, greater safety in travel is vitally important. Many accidents must be prevented. For every man-hour saved is essential to victory. That is why efficient and dependable street lighting is so necessary . . . especially in dimout areas. For the failing of only one lamp causes an isolated blackout spot that is hazardous to the life of many workers.

And more and more Slater Lamps are being used to provide greater safety for America's night fighters. Whether traveling to the great shipyards in Portland, Oregon, or through the traffic of Providence, R. I., New York, and many other cities, Slater Lamps are serving efficiently and dependably . . . delivering a high lumen output at low cost . . . with long lamp life assured. Catalog upon request.

SLATER ELECTRIC & MFG. CO.
BROOKLYN, NEW YORK
MANUFACTURERS OF STREET LIGHTING LAMPS, AND PRECISION ELECTRONIC TUBES

The latest, most accurate coverage of

WARTIME CHANGES

in

ELECTRIC UTILITY

operations and personnel

•

THE 1943 WARTIME EDITION

of the

McGRAW CENTRAL STATION DIRECTORY

•

If you work in or sell to the electric utility field, you'll need the 1943 wartime edition of the McGraw Central Station Directory.

War conditions have had a tremendous influence on electric utility operations and personnel. Shifts in popu'ation have changed the size and importance of many utilities as power needs for war industries and housing have developed. New men have come in to replace technically-trained employees now in the armed forces. Other key men have shifted jobs in the same organization or have moved to different companies.

Gasoline rationing and selective service have also cut the sales force of the manufacturer serving the estimated 1943 utility market of $300,000,000. To avoid wasted time and money spent in mail or personal contact work, correct, up-to-date facts are essential, whether for engineering, selling, contracting or statistical purposes.

The 1943 wartime edition lists every discoverable utility change occasioned by war conditions. For each of 4,000-odd utility plants you'll find exclusive data on organization, personnel, equipment and operations.

For intelligent, productive wartime and postwar planning or selling, a copy of the 1943 wartime edition of the McGraw Central Station Directory should be in the hands of every executive responsible for such plans.

Because of paper curtailment, this edition will be limited. Order your copy at once.

•

McGraw Central Station Directory

A McGraw-Hill Reference Service

330 West 42nd Street, New York, N. Y.

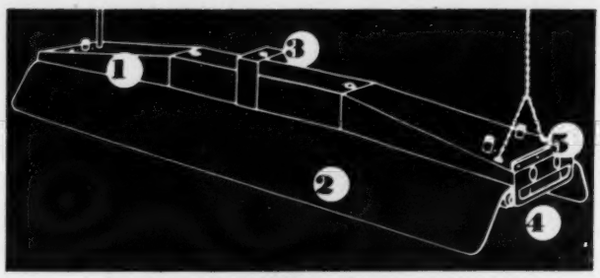
HERE'S THE NEW... Guth

The Latest and Best IN FLUORESCENT LIGHTING!

FFICIENT! SIMPLE! PRACTICAL! ATTRACTIVE! EASY-TO-CLEAN!

❶ geniously engineered Accessory Housing—long—ean—good looking—and ugh! Meets W. P. B. metal mitations. Die-formed from single piece of steel.

❷ asonite "REFLECTOR-OARD" Reflectors; formed our plant, rigidly checked, quality controlled. Finished "300° White" (88% F.). Reflector easily removed and reinstalled, with "Flexible Triggers."



❸ Hang it anywhere—anyway! K.O.'s for conduit and chain. Sliding hanger for outlet spacing variations.

❹ Supports for Eggcrate Louvres, when desired. Louvres can be attached to standard units, initially or at later date.

❺ "Bump-Proof" end-plates give added lampholder protection. Starters easily accessible even when SUPER-ILLUMINATORS are mounted directly at ceiling.

For full details on the GUTH Super-Illuminator, Write for Catalog Sheet No. 744.

★ ★ ★ ★ ★ ★ ★ ★

Leaders in Lighting Since 1902 **Guth**

★ ★ ★ ★ ★ ★ ★ ★

THE EDWIN F. GUTH CO. • 2615 Washington Ave. • St. Louis, Mo.

THE EXECUTIVE WHO STOPS TO THINK . . .

Knows that "10% for War Bonds isn't enough these days"

Workers' Living Costs going up . . . and Income and Victory Tax now deducted at source for thousands of workers . . .

Check! You're perfectly right . . . but all these burdens are more than balanced by *much higher* FAMILY INCOMES *for most of your workers!*

Millions of new workers have entered the picture. Millions of women who never worked before. Millions of others who never began to earn what they are getting today!

A 10% Pay-Roll Allotment for War Bonds from the wages of the family bread-winner is one thing—*a 10% Pay-Roll Allotment from each of several workers in the same family is quite another matter!* Why, in many such cases, it could well be jacked up to 30%—50% or even more of the family's *new* money!

That's why the Treasury Department now urges you to revise your War Bond *thinking*—and your War Bond *selling*—on the basis of *family* incomes. The current War Bond campaign is built around the family unit—and labor-management sale programs should be revised accordingly.

For details get in touch with your local War Savings Staff which will supply you with all necessary material for the proper presentation of the new plan.

Last year's bonds got us started—*this year's bonds are to win!* So let's all raise our sights, and get going. If we all pull together, we'll put it over with a bang.

This space is a contribution to America's all-out war effort by

ELECTRICAL WORLD

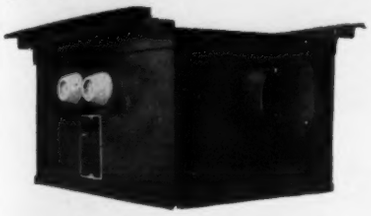
you've done your bit
. . . now do your best!

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

COLD CATHODE LIGHTING

THE LIGHT SOURCE OF THE FUTURE

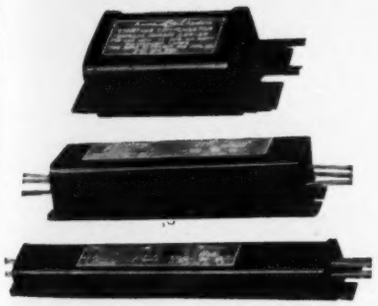
The exceptional performance of Cold Cathode Lighting in industrial and commercial installations proves conclusively the advantages of this form of lighting. Cold Cathode lighting provides a continuous-tube source of light, designed in form and color harmony to exact production line needs or to the architectural effect of the building. High efficiency; long lamp life; exceptional performance; economical.



Industrial Type Cold Cathode Lighting Transformer

The most important unit in a Cold Cathode Lighting installation is the transformer. Specify Acme, the transformers Cold Cathode experts prefer. Practical designs to meet every installation requirement. Operating characteristics which provide for maximum performance and efficiency. Write for Cold Cathode Lighting Bulletin.

and for Maximum Performance of Fluorescent Lamps



Leading fixture manufacturers choose Acme transformers on a performance basis. Designed to exactly meet the operating requirements of the lamp. Balanced secondary voltage. Impregnated coils, compound filled case, minimizes resonance. Built in all sizes (permitted by WPB) in single, two, three and four lamp types. Write for Bulletin 157.

THE ACME ELECTRIC & MFG. CO.
43 Water St., Cuba, N. Y.

Acme ACME Electric
TRANSFORMERS

At last!
REALLY DEPENDABLE, TROUBLE-FREE FLUORESCENT LIGHTING

made possible by the exclusive developments of Artkraft

ARTKRAFT

"LONG LIFE"*

HOT CATHODE FLUORESCENT LIGHTING SYSTEMS

1. **NO STARTER SWITCHES**—Artkraft resonant starting eliminates this trouble-maker which has always required constant servicing and replacement.
2. **THE ONLY GUARANTEED LAMP**—Guaranteed for 3,000 hours. Rated life 5,000 to 6,000 hours.
3. **CONSTANT VOLTAGE POWER PACK**—Efficient operation at 85 to 135 volts. Good lighting assured where overloaded lines and wide fluctuations of voltage make impossible the use of all other fluorescent systems. Also adaptable to 220 and 440-volt systems, single or three-phase. Cannot short-circuit the line.
4. **CONSTANT-TEMP HOT CATHODE**—Corrugated mesh ribbon filament permits the use of abundantly more emissive compound, and control of secondary voltage and Constant-Temp feature furthermore prevent rapid discharge of this compound.
5. **BLACKENING IN LIGHT COLUMN REDUCED** by exclusive cathode design, assuring a brighter lamp.
6. **100% POWER FACTOR** at rated voltage. 98% or over within 85 to 135-volt range.
7. **"EASY MOUNT" LUMINAIRE** permits instant removal, without tools, for cleaning non-ferrous reflector or lamps.
8. **STROBOSCOPIC (FLICKERING) EFFECT SUBSTANTIALLY REDUCED.**
9. **BALLAST REPLACEMENTS UNKNOWN.**
10. **MORE LIGHT FOR THE SAME CURRENT.**
11. **FIELD TESTED FOR OVER FIVE YEARS.**
12. **MODERATE FIRST COST.**
13. **EXCLUSIVE FEATURES RADICALLY REDUCE MAINTENANCE COSTS** and save many man-hours.

Write for Folder F-102

WHOLESALERS: Write for proposition.

FIXTURE MANUFACTURERS:

Investigate our licensing proposition at once. Artkraft Systems are now available through the manufacturing and distributing facilities of
EDWIN F. GUTH CO.
F. W. WAKEFIELD BRASS CO.
FOSTORIA PRESSED STEEL CORP.

SIGNS* OF LONG LIFE

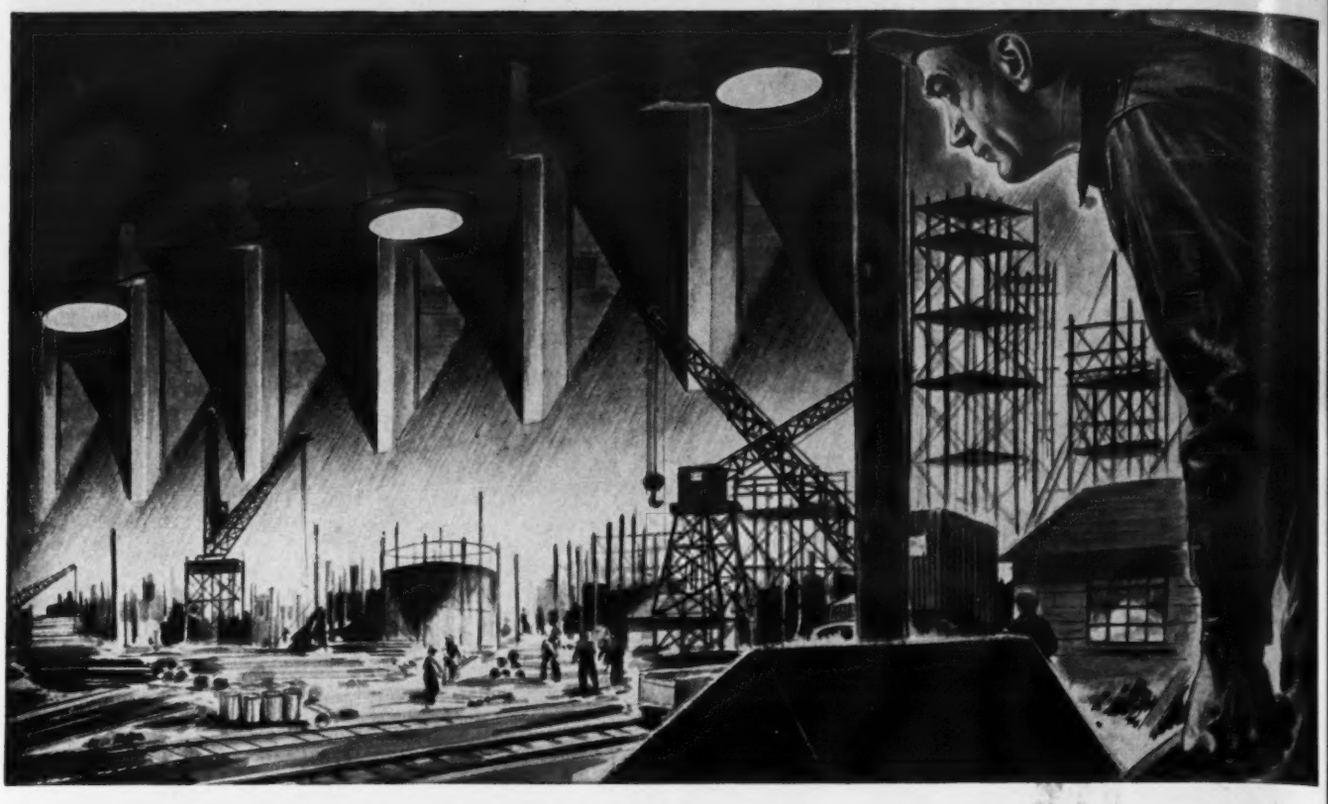
ARTKRAFT
HOT CATHODE
FLUORESCENT LIGHTING
Division of
THE ARTKRAFT SIGN COMPANY

1115 E. Kibby St. **Lima, Ohio, U. S. A.**

LONG LIFE **DEPENDABILITY**

*Reg. U. S. Pat. Off.

ONLY AN ELECTRICAL WHOLESALER COULD THUS SPEED WAR PRODUCTION



Hand-made light fixtures saved 60 days

Wesco-built In 6 Hours They Enabled War Dam Night Shift to Start On Time

Construction of the Pacific Coast hydro-electric dam was losing the race against war plant power needs. A night shift was established but special weatherproof lighting fixtures were unobtainable for 60 to 90 days. The General Superintendent phoned Wesco in the emergency—"At 5 tonight 12 reflectors to meet our needs must be ready."

The Wesco manager knew that dim-out regulations forbade the use of floodlights. The solution was to suspend weatherproof reflectors from cables stretched across the ravine. But suspension fittings could not be had. Combing his stock, the Wesco Manager put together a 1000 Watt reflector, a close pipe nipple and a type "C" condulet and thus improvised a thoroughly waterproof lighting unit. The 12 fixtures were made in 6 hours and were ready on time.

Wesco ingenuity and know-how will be at the service of business and industry following the unconditional surrender of the Axis.

WESCO SPEEDS WAR PRODUCTION

* War plant burned down on a Friday was operating on the following Monday—thanks to Wesco's prompt delivery of motors, switches, wire, and other items from local stocks.
* Within three days Wesco completed delivery of 68 different items to an important war plant. Best delivery of other sources was 12 weeks.

WESCO SERVES BUSINESS

* By buying large quantities at low prices and passing the savings on to small-quantity buyers.
* By furnishing informative and technical data.
* By knowing local and national codes and rulings.

Westinghouse Electric Supply Co.

150 VARICK STREET • • NEW YORK (13), N. Y.

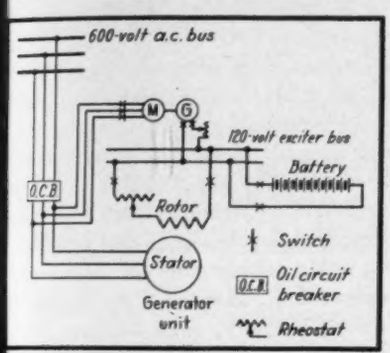
A NATIONAL DISTRIBUTING ORGANIZATION WITH 80 BRANCHES

HOW DESIGN... CONSTRUCT OPERATE MAINTAIN

Battery Used in Starting Exciters

By H. W. YEATON
Engineering Department
Central Maine Power Company, Portland

One of the steam plants in the Portland district of this system is equipped with motor-generator exciters, and formerly could not be started except by energy from an outside source. It appeared that in certain emergencies it would be very desirable to be able to start this plant even if energy was not available for excitation, and therefore it was arranged to utilize a 120-volt, 120-amp.-hr. Exide storage battery already in use for circuit breaker operation for excitation long enough to start the motor-driven exciter equipment in the station.



CONNECTIONS for using circuit breaker control battery for starting motor-driven exciters

The procedure is as follows: The steam turbine is brought up to speed and the switch is closed connecting the motor-generator exciter to the a.c. bus, which is dead. The generator field switch is then closed to the exciter bus, also dead, and the switch immediately closed which connects the battery to the exciter bus. The motor-generator starts instantly; voltage is built up on the exciter, and it is paralleled with the battery, and the battery switch opened. This takes but a few seconds, so that the drain on the battery is very small. In stopping, the generator and exciter rheostats are adjusted to marked positions to be ready for the best conditions for starting, and starting is practiced monthly on this basis so that operators will be familiar with the emergency starting conditions.

•

Typewriting on Film Records Saves Time

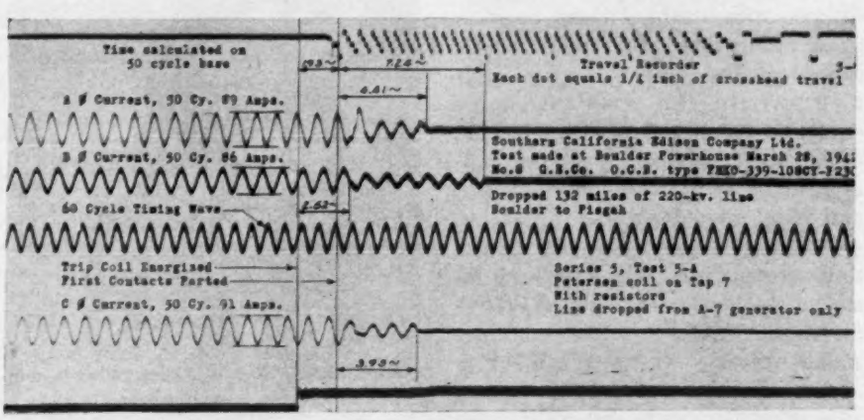
By W. C. CURL
Engineer, Southern California Edison Company, Los Angeles

Study of oscillogram test results can be speeded up materially by typewriting the test data directly on the oscillogram film negative. Legible and compact notation results and the completed oscillogram negative will make excellent blueprint reproductions. A special typewriter ribbon must be used and the writing must be protected by applying a coat of clear lacquer before the oscillogram is ready for printing.

First the oil of finger marks should be removed from the film with a soft dry cloth, or the cloth may be moistened with alcohol or carbon tetrachloride. All calibration lines should then be ruled on with India ink. The negative should then be mounted on a very thin cardboard with scotch tape along the top and bottom edges. The mounting permits writing near the edges and also provides a means for holding the film back from the moving parts of the typewriter.

A special ribbon called "opaque" should be used. The moist carbon on such a ribbon makes a heavy clean-cut letter on the film, but the writing does not dry. It is best to brush the type frequently to assure clean-cut writing. Errors are easily wiped off with a soft dry cloth.

A lacquer coating must be applied over the writing to bond it to the film and prevent smearing during the blueprinting process. Such lacquer is available at photographic supply houses. A fixative solution sold at art stores for use on pencil and char-


Time calculated on 50 cycle base
Travel Recorder
Each dot equals 1/4 inch of crosshead travel
A ϕ Current, 50 Cy. 89 Amps.
B ϕ Current, 50 Cy. 86 Amps.
Southern California Edison Company Ltd.
Test made at Boulder Powerhouse March 28, 194
60 Cycle Timing Wave
Dropped 132 miles of 220-kv. line
Boulder to Pisgah
Trip Coil Energized
First Contacts Parted
Series 5, Test 5-A
Peterson coil on Tap 7
With resistors
Line dropped from A-7 generator only
C ϕ Current, 50 Cy. 91 Amps.

BY TYPEWRITING LEGENDS and other test data on oscillograph films upward of 80 percent of the time required for hand lettering is saved; corrections also can be made

coal drawings also may be used. If the fixative solution is used, it should be diluted with two parts of thinner to one part of fixative solution.

The art stores also sell a mouth-operated atomizer made especially to apply fixative. This article is a good choice because it cleans out easily. A bulb-operated atomizer is a nuisance because it clogs up quickly. The lacquer will soften the writing and if applied with too much force the letters will flow or smear. Hold the negative about 15 in. away from the atomizer while applying the fixative, which will then float onto the film as a fog and the writing will remain intact. The lacquer will dry in ten minutes. If the work becomes spoiled the negative can be cleaned off easily with a cloth saturated with lacquer thinner. This operation will also remove the inked calibration lines, but it will not remove the silver image from the negative.

The accompanying illustration shows the results obtained by this method. The work was done with an "opaque No. 3, 12-yd. cotton ribbon" sold by the KeeLox Manufacturing Company. Diluted fixative solution was applied with a mouth-operated fixative atomizer. The writer has used this method for three years. Use of the typewriter saves about 80 percent of the time required for hand lettering.

•

Replace 33-Kv. Fuses From Safety Rack

By B. J. HUNGATE
Manager Franklin Division
Union Electric Co. of Missouri, Washington

Accompanying pictures show the fuse-changing rack which has been erected at Franklin substation of the Union Electric Company to provide linemen with a safe working position from which they can replace 33-kv. repeating fuses during severe lightning storms. The small investment necessary for these racks has paid big dividends in shorter customer outages, safe work, contented linemen and fewer frayed nerves.

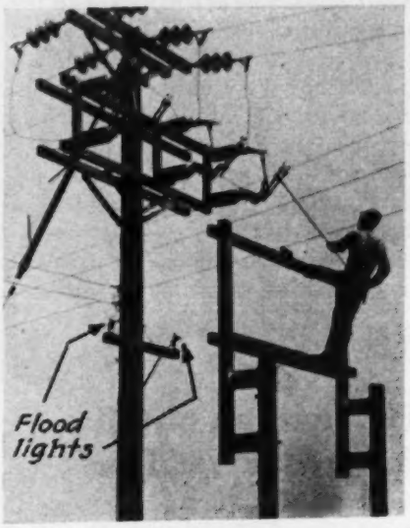
At the 132-33-kv. Franklin substation, where these racks have been installed, there are four sets of 33-kv., three-shot repeater fuses on lines which traverse territory subject to severe lightning storms. One line in particular, which is some 28 miles long, has experienced a large number of outages due to lightning. Often in the past during heavy storms it was necessary to kill this line before repeater fuses could be safely replaced, thus causing an outage of several minutes.

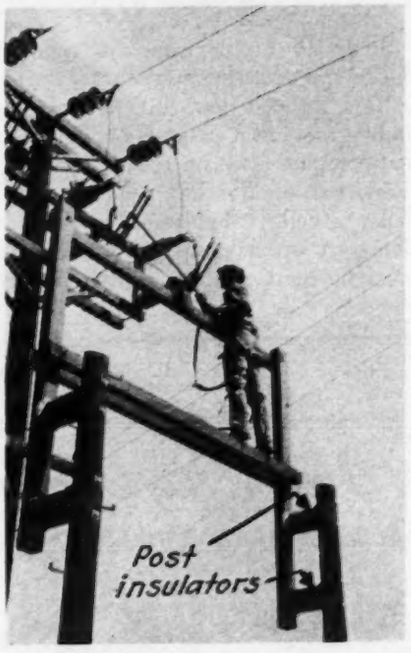
The racks—they are not platforms—were devised to solve this problem, and since their installation, they have worked to our entire satisfaction, linemen in particular being happy about the arrangement. The illustrations are largely self-explanatory. Two lightweight poles, five crossarms, four standard station post Lapp insulators and a few bolts did the job.

During the heaviest of rains the fuses can now be replaced, as they blow, with absolute safety. Next to the safety feature, the important point is that customer service is interrupted only momentarily as the various fuses blow. No switch has to be opened and customers put out of service to replace fuses. Another feature of the rack is that the lineman is out in front of the fuse and hot metal from blowing fuses does not go down the lineman's neck.

It will be noted particularly that a spare fuse holder is fastened to the top bar of the rack. This gives the lineman an ample supply of spare fuses and the right fuse size at the right place.

As a second improvement, floodlights have been installed on a short crossarm under the 33-kv. fuse assembly. These are standard PAR-38 floodlights and they do an excellent job, since they add to the speed and general safety of replacing the fuses.





FUSE-CHANGING RACK contributes to the safety of lineman replacing fuses in 33-kv., three-shot repeater fuses during severe storms

•

Cable Sheath Breaks Repaired In Duct

By T. G. HIERONYMUS
Superintendent of Underground
Kansas City Power & Light Company,
Kansas City, Mo.

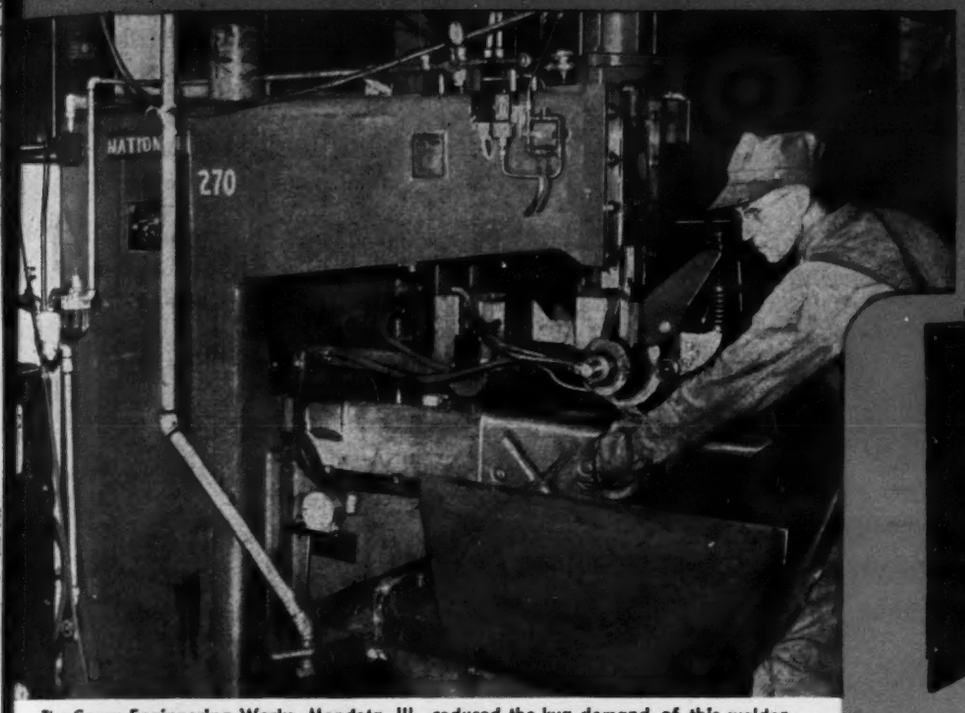
In peacetime when the presence of oil in cable duct sections indicated the existence of a sheath rupture normal procedure would be to remove the damaged cable and pull in a new section. To further the war effort, by conserving cable stocks and by reducing cable outage time for repair and replacement, Kansas City Power & Light Company, as a wartime practice, now locates the sheath rupture and repairs it in place by lead burning without removing the cable from service.

This practice has been used successfully in several instances on a 400,000-cir.mil, three-conductor, paper-insulated, lead-covered 13.2-kv. cable serving a war industry load operating 24 hours a day. This particular cable had been in service since 1928. Ratcheting action of the cable under the influence of load cycles and expansion of oil has picked weak spots in the lead sheath and resulted in occasional longitudinal breaks in the cable sheath along its length.

Section of the cable in which the rupture is located is found by applying nitrogen gas under pressure to the cable through fittings on the grease-filled joints and noting the speed with which the pressure drops. Pressure

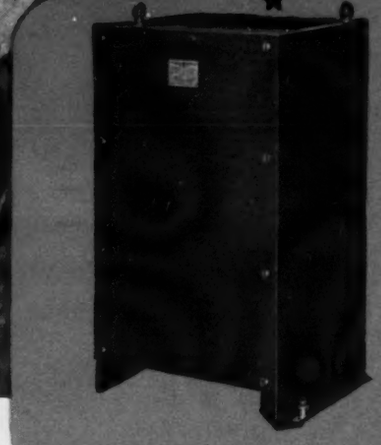
TO REDUCE KVA DEMAND OF RESISTANCE WELDERS

USE G-E PYRANOL CAPACITORS



The Conco Engineering Works, Mendota, Ill., reduced the kva demand of this welder from 150 kva to 54.6 kva by installing series capacitors (partly shown at left). A serious wiring and power-factor problem within the factory was solved, and a bad light flicker in town was eliminated. The capacitors added only 14 per cent to the installed cost of the welder.

Series-capacitor equipment for improving power factor of resistance-welding machines



PROBLEM

elding loads present a problem both resistance-welding machine ers and utility companies. First, cause the power demand is high, d the power factor is low. Second, e load is single phase, causing balance on polyphase systems. hird, the duty is highly intermitnt, causing light flicker.

SOLUTION

apacitors can be used in series th the primary of the welding nsformer to reduce kva demand m the line by improving power ctor to approximately unity.

RESULTS

- **More welding machines can be used on an existing feeder.**
- **Heavier welds are possible on the feeders where capacitors have been installed.**
- **Reduced interference with other welders on the same feeder.**
- **Welding machines can be installed on feeders too small to supply the usual low-power-factor machines.**
- **Removal or lessening of the restrictions sometimes required by power companies.**
- **Reduction of light flicker.**
- **Smaller feeder and power-supply equipment are needed for new welders.**
- **The necessity of running a separate feeder for a welder can probably be avoided.**
- **Special, low-impedance, power-supply transformers are not necessary.**
- **Long-throat machines will have practically the same kilowatt demand as short-throat machines.**

Application information can be obtained by asking for Bulletin GET-1134. For specific recommendations call your G-E representative. He'll be glad to help you. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

407-54-5790

drops most rapidly at points adjacent to the rupture section.

Since the duct is buried 3 to 4 ft. deep in the parkway area between the sidewalk and the curb in most places, actual physical location of the rupture is not difficult. A series of "tests" holes 5 to 6 ft. long are dug to the side of the duct. A hole is then broken in the concrete envelope and a hole made in the fibre conduit large enough to admit a finger to feel for oil. By digging a hole at the center of the 400-ft. section, inspecting for oil, and then driving other similar test holes to divide the remaining "down-hill" portion of the cable section in half the rupture can be found by digging a maximum of six test holes.

When the rupture is located the cable is exposed through the duct wall for a length sufficient to permit the sheath break to be sealed by a lead burning. The breaks in the concrete duct envelope at test holes and where the repair is made are closed with fresh concrete.

Location of sheath ruptures by this method involves the expenditure of a certain amount of semi-skilled labor, but the work is done as a fill-in job during periods when no more pressing work is pending. A number of breaks have been repaired in this manner during the past year with complete success, so far as can be seen at this time.

•

Metal-Clad Gear in "Big Inch" Stations

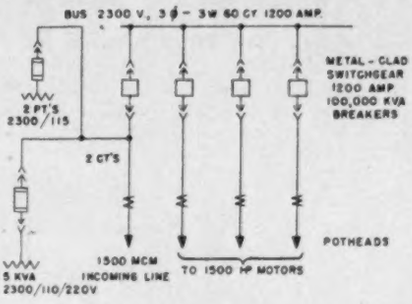
By J. H. METZ and J. C. HOYT
Switchgear Division, General Electric Company

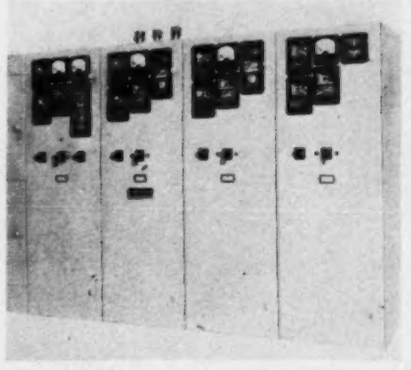
Each pumping station on the "Big Inch" pipeline is so arranged that it not only keeps the oil flowing but also overcomes trouble by permitting diversion of the flow through a by-pass if a pump should fail, enabling the other pumps and stations along the line to carry on.

The station building is divided into two rooms by means of a firewall, with only outside entrances to each room. The pumps are in one room and the switchgear and motors are in the other. The motor shafts, which go through the firewalls to the pumps, have specially packed glands to prevent any oil vapor from entering the switchgear room.

In the motor room of the standard station there are three 2,300-volt, 1,500-hp., 1,800-r.p.m. motors and associated control and protective switchgear. Metal-clad gear is used. With this type of equipment, a breaker can be rolled out and replaced by a spare in a matter of a few minutes, if necessary. Breakers in all stations are of the same type and capacity.

The accompanying illustrations


BUS 2300 V, 3 ϕ - 3W 60 CY 1200 AMP
METAL-CLAD SWITCHGEAR 1200 AMP 100,000 KVA BREAKERS
2 PT'S 2300/115
2 CT'S
POTHEADS
1500 MCM INCOMING LINE
TO 1500 HP MOTORS
5 KVA 2300/110/220V



STANDARD electrical design and switchgear assembly of "Big Inch" pipe line pumping stations

show a one-line diagram of the power circuits and the standardized metal-inclosed switchgear equipment used where full voltage starting is employed. In the picture the unit on the left contains the drawout potential transformers and the control power transformer with its drawout-type fuses. The four other units are for the incoming line and the three motor feeders.

The incoming line unit is equipped with voltmeter, ammeter and watt-hour meter and with inverse time overcurrent relays to provide back-up protection of the motor circuits. A phase sequence and undervoltage relay prevent any motor from being started in case of phase reversal or of open phase and will shut down the motors in case of failure of power supply.

On each motor feeder unit is an ammeter for watching the motor load. A two-element thermal relay prevents damage to the motor winding by opening the circuit breaker in the event of sustained overload. Two inverse-time over-current relays with instantaneous trip elements furnish fault protection. A phase sequence and undervoltage relay is also included to guard against loss of potential on the incoming line and to prevent simultaneous starting of all motors when power is restored.

Other switchgear relays and devices are also included as a part of the equipment, to take care of failures in other pumping stations. An alarm is sounded in case the intake oil pressure drops below approximately 12 lb., which would indicate some difficulties in the preceding pumping station. If the pressure continues to drop, at approximately 5 lb., a relay operates and opens circuit breaker of pump No. 3; fifteen seconds later, if the pressure has not been recovered, it will trip the breaker of pump No. 2; in another fifteen seconds, the breaker of No. 1 opens. If necessary, pumps can be by-passed by manual operation of the valves. Three-phase lightning arresters and capacitors furnish additional protection to the equipment.

To start the station, when intake pressure from the preceding station comes up to 20 lb. or more, No. 1 motor is started and by-pass valves are operated manually to feed oil to this pump. When the intake pressure has again reached approximately 20 lb. motor No. 2 is started, and this is repeated for No. 3. These three pumps step up pressure to around 750 lb. If the pressure goes above approximately 1,000 lb., a pressure switch closes and energizes a relay which opens the incoming line circuit breaker and shuts down the station.

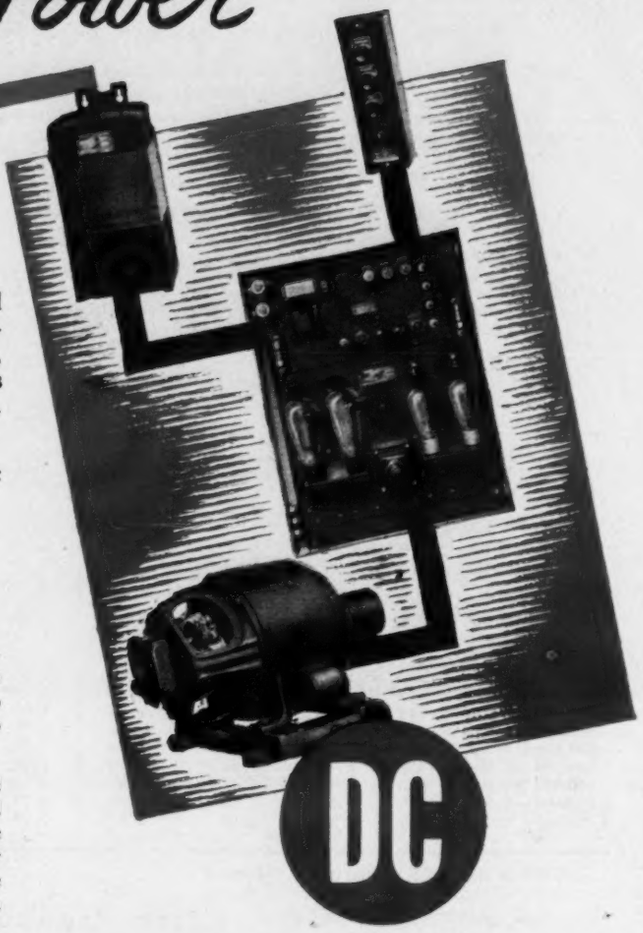
•

Cost of 12-Pole Line Run

(From an Eastern utility's field sheets)

11	30-ft. wooden poles with crossarms	$ 99.00
1	35-ft. wooden pole with crossarms	12.56
	No. 6 line wire, 3,643 ft.	61.29
	Guy wire, 250 ft.	5.00
19	6-pin crossarms	28.50
38	Insulators, 4 kv.	4.18
2	Anchors with rod	4.42
	Miscellaneous material	9.31
	Store room charge	22.42
	Transportation expense	4.92
	Insurance and taxes	4.21
	Clerical and supervision cost	7.50
	Engineering expense	27.03
	Company labor	92.41
	Total	$382.44

Now Electronics Gives You Full-range Variable-speed Drive from AC *Power*



G-E THY-MO-TROL DRIVE Provides Full Control on a Single Dial

Complete Drive—Nothing Else to Buy. Thy-mo-trol drive is a complete equipment, its d-c motor operating from your a-c power line. Starts, accelerates, controls speed, stops by dynamic braking, and reverses the motor—all from a single, compact control station. And it fully protects the motor.

Makes available previously unused advantages of d-c motors, such as:

1. **Full-range, Stepless Speed Control**
2. **Constant Speed under Changing Load**
3. **Full Torque at Low Speeds**
4. **Smooth, Fast Current-limit Acceleration**

Dozens of Other Thy-mo-trol Extras . . . such as: low maintenance (by elimination of moving parts); preset speed before starting; space saving; no stop for speed change; easy to control automatically; operation direct from a-c line—no motor-generator or other special d-c supply needed.

Where Has It Been Applied? Drill presses, to increase speed range and kinds of work handled. Grinders, for precise speed selection and improved finish. Milling machines, to increase variety of work handled, and to simplify design. Propeller governor testing, for accurate, smooth speed control. Cable reelers, to maintain constant tension. Conveyors, to match speeds.

How to Buy Thy-mo-trol Drive. Because electronic motor control offers so many advantages through improved machine design, performance, and operating technique, G-E engineers want to consider each of your problems as an individual case. Standard Thy-mo-trol drives can be obtained in sizes up to 10 hp. Special types can also be provided. For further information write, stating your problem, to any G-E office, or to General Electric, Electronic Control Section, Schenectady, New York.

THY-MO-TROL DRIVE is easy to install. These four compact units—d-c motor, electronic panel, compact control station, and small power transformer—make up the complete drive.

ANOTHER G-E "FIRST" IN INDUSTRIAL ELECTRONICS

GENERAL ELECTRIC

676-105-8980

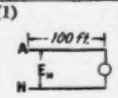
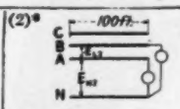
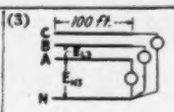
VOLTAGE DROP FOR CONDUCTORS CARRYING CURRENTS OF MAXIMUM CODE RATING

By E. S. OBERNDORF, Electrical Engineer, Department of Public Works, Bureau of Sewage Disposal Design, City of New York

Tabulation gives voltage drop *(IR)* and percent voltage drop in copper conductors from No. 14 AWG to 1,000,000 cir.mil for the maximum current allowed by the 1940 National Electrical Code. Values are given for drop between line wires and from line to neutral for 120-volt, single-phase circuits (which apply also to direct current), for 120/208-volt and 440-volt, three-phase circuits, and for two phases of a 120/208-volt, three-phase circuit.

Voltage Drop per 100 ft. Distance to Load (Balanced Loads, Inductance Neglected)

For N.E.C. 1940—Maximum Current Rating—3 Conductors in One Conduit—Type RHT and RH—Rubber Insulation—At 25 Deg. C., 77 Deg. F.—10.37 Ohms/Cir.mil-Foot

Conductor Characteristics				Volts Drop					Percentage Drop					
				(1) 	(2)* 		(3) 		(1)	(2)		(3)		
Wire Size, AWG. and Cir. Mil	Resistance per 100 ft., Ohms	Maximum Capacity, Amp.	Volts Drop per 100 ft. of Wire, at Max. Amp.	Direct Current or Single Phase	Load on 2 Ph. (of a 3- Ph. Syst.)		3 Phase		1 Phase	2 Phases (of a 3-Phase Sytem)		3 Phase		3 Phase
				Drop in E_N	Drop to Each Phase Load E_{N2}	Drop to Load Between Line Wires E_{L2}	Drop to Each Phase Load E_{N2}	Drop to Load Between Line Wires E_{L2}	E_N = 120 V.	E_N = 120 V.	E_L = 208 V	E_N = 120 V.	E_L = 208 V.	E_L = 440 V.
									Drop as % of E_N	Drop as % of E_{N2}	Drop as % of E_{L2}	Drop as % of E_{N2}	Drop as % of E_{L2}	Drop as % of E_{L2}
14	0.252	22	5.57	11.14	8.36	9.65	5.57	9.65	9.28	6.96	4.64	4.64	4.64	2.19
12	0.158	27	4.26	8.52	6.40	7.37	4.26	7.37	7.09	5.30	3.53	3.53	3.53	1.67
10	0.099	37	3.66	7.32	5.49	6.33	3.66	6.33	6.10	4.55	3.03	3.03	3.03	1.44
8	0.063	49	3.08	6.16	4.62	5.33	3.08	5.33	5.13	3.84	2.56	2.56	2.56	1.21
6	0.039	65	2.53	5.06	3.80	4.38	2.53	4.38	4.21	3.15	2.10	2.10	2.10	0.99
4	0.025	86	2.15	4.30	3.23	3.72	2.15	3.72	3.58	2.67	1.78	1.78	1.78	0.84
2	0.0156	115	1.79	3.58	2.69	3.10	1.79	3.10	2.98	2.23	1.49	1.49	1.49	0.70
1	0.0123	131	1.61	3.22	2.42	2.78	1.61	2.78	2.68	2.00	1.33	1.33	1.33	0.63
1/0	0.0098	151	1.48	2.96	2.22	2.56	1.48	2.56	2.47	1.85	1.23	1.23	1.23	0.58
2/0	0.0078	173	1.35	2.70	2.03	2.33	1.35	2.33	2.25	1.68	1.12	1.12	1.12	0.53
3/0	0.0062	199	1.23	2.46	1.85	2.13	1.23	2.13	2.05	1.53	1.02	1.02	1.02	0.48
4/0	0.0049	230	1.12	2.24	1.68	1.93	1.12	1.93	1.87	1.39	0.93	0.93	0.93	0.44
250,000	0.00414	255	1.05	2.10	1.58	1.82	1.05	1.82	1.83	1.30	0.87	0.87	0.87	0.41
300,000	0.00345	285	0.98	1.96	1.47	1.69	0.98	1.69	1.63	1.21	0.81	0.81	0.81	0.38
350,000	0.00296	311	0.92	1.84	1.38	1.60	0.92	1.60	1.53	1.15	0.76	0.76	0.76	0.36
400,000	0.00260	336	0.87	1.74	1.31	1.51	0.87	1.51	1.45	1.08	0.72	0.72	0.72	0.34
500,000	0.00207	382	0.79	1.58	1.19	1.37	0.79	1.37	1.32	0.99	0.66	0.66	0.66	0.31
600,000	0.00172	422	0.73	1.46	1.10	1.26	0.73	1.26	1.22	0.90	0.60	0.60	0.60	0.29
750,000	0.00137	475	0.65	1.30	0.97	1.12	0.65	1.12	1.08	0.81	0.54	0.54	0.54	0.25
900,000	0.00115	490	0.56	1.12	0.84	0.97	0.56	0.97	0.93	0.71	0.47	0.47	0.47	0.22
1,000,000	0.00103	543	0.56	1.12	0.84	0.97	0.56	0.97	0.93	0.71	0.47	0.47	0.47	0.22

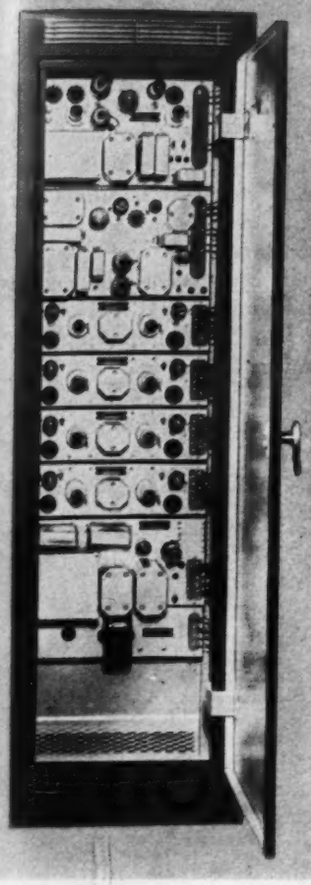
*Drop in E_{N2} = 1.5 × drop in E_{N2} (Approx.)

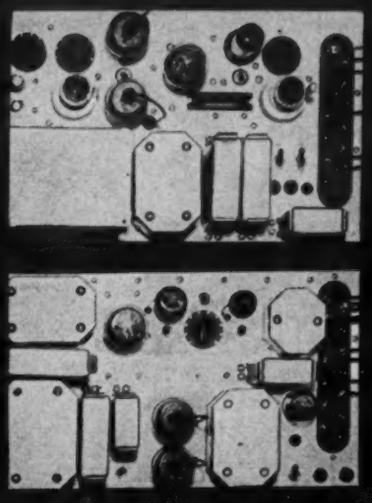
NOTES REGARDING USE OF TABLE

Used in calculation, a value is selected for a given size of wire and circuit arrangement. Corrections are made for the ratio of the actual length of the circuit to 100 ft. and for the ratio of the actual load current to the rated maximum amperes allowed by the code.

The table emphasizes the increase in the amount of copper per unit of current when large wire sizes must be used. It will be noted that the voltage drop in the 1,000,000-cir.mil size is practically one-tenth of that in the smallest size, No. 14 AWG. This, of course, is due to the fact that as the diameter of a wire is increased its radiating surface increases as the first power of the diameter, while the cross-section and weight increase as the square of the diameter. In other words, the circular mils per ampere (cir.mils/amp.) increase with larger conductors because of heat considerations. It can readily be shown that voltage drop in a foot of conductor equals the ohms per circular mil-foot (a constant for a given material and temperature) divided by the circular mils per ampere. The circular mils per ampere thus is a measure of the voltage economy of a circuit.

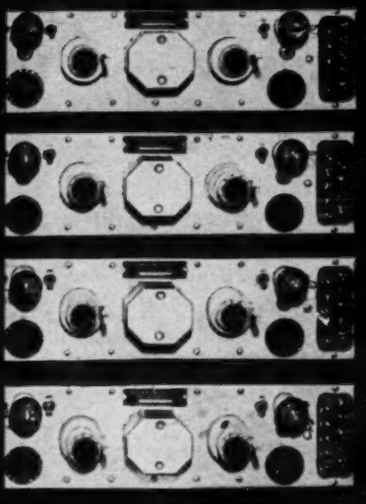
It can be shown that the more nearly uniform the circular mils per ampere are maintained in a wire system the less the voltage drop, as well as the cost, will be for a given total amount of copper. It is of course difficult to maintain a great degree of uniformity in practice, as it is customary to use every other size of wire in the AWG gage, giving a jump of 59 percent as a wire is increased to the next standard size, except in sizes above No. 2, when the increase is 26 percent. However, it may often be found that mains may be made larger and branches smaller, or vice versa, with an improvement in voltage drop or copper economy.





BASIC TRANSMITTER AND MODULATOR

How many more kilowatt hours can your system deliver with carrier current?



AUTOMATIC LOAD CONTROL

TELEMETERING

SUPERVISORY CONTROL

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Carrier current can provide 9 major services

Power companies today are broadening their use of G-E unit-type carrier-current equipment to include almost all of the nine major carrier-current functions. By doing so, they appreciably increase their ability to deliver more kilowatt hours and thus prepare for growing energy needs.

Superimposed on existing power lines, G-E carrier current is, in many cases, making unnecessary the construction of new power lines and power apparatus that would require large amounts of strategic war materials. . . . Carrier current permits:

1. Tap points for new war loads from major transmission lines without appreciably impairing their reliability.

2. Increased interconnections between systems to help boost kilowatt deliveries.

3. Safe loading of existing lines closer to their stability limits.

Complete new carrier-current equipment to meet your requirements can be supplied from G-E standard rack-units and accessories. You save engineering time and avoid "specials." Remember that the design and performance of G-E carrier-current equipment have been proved in service.

Companies that install modern G-E carrier current can add units as needed to handle new functions . . . easily, quickly, without scrapping other equipment . . . and at low cost. These compact "packaged" units are self-contained for easy installation.

It will pay you to investigate now the possibility of applying carrier current to your system for:

Pilot relaying. Transferred tripping. Line sectionalizing. Supervisory control. Signaling. Telemetering. Automatic load control. Telephony. Line-potential from carrier coupling capacitors.

Your G-E representative will gladly discuss the advantages to you of new or additional equipment. . . . *Electronics Department, General Electric, Schenectady, N. Y.*

• *Tune in General Electric's* World Today *and hear the news from the men who see it happen, every evening except Sunday at 6:45 E. W. T. over C. B. S. network. - On Sunday evening hear General Electric's Mazda Lamp program over N. B. C.*

GENERAL ELECTRIC

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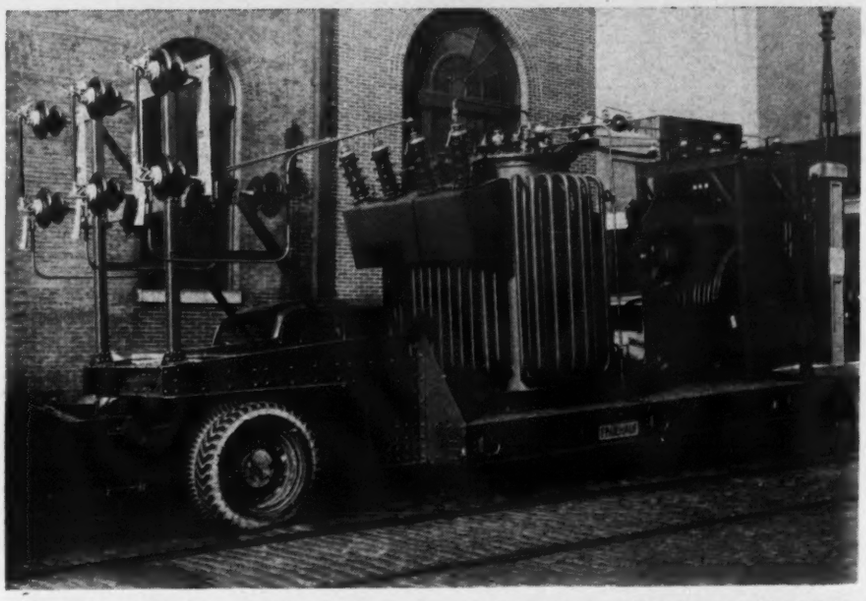

PORTABLE 1,000-kva., 33-13/4-kv., three-phase substation to which was added lightning arresters and induction feeder regulators

Experience With Portable Substations*

By R. McC. BYERS
Assistant to the Electrical Engineer, Consolidated Gas, Electric Light & Power Company of Baltimore

Use of a 1,000-kva. portable substation has reduced the need for operating spare transformers and expensive 4,150-volt tie facilities for 30 small rural distribution substations on the system of the Consolidated Gas, Electric Light & Power Company of Baltimore. Total cost for the unit amounted to approximately $18 per kva.

The portable substation, put in service in 1937, has a 1,000-kva., three-phase, OISC transformer with a tertiary winding and provisions for future forced-air cooling. Terminal board connections are available through the handhole in the cover to provide for star-star operation from 33 kv. or 13 kv. to 4 kv. or to 2.5 kv. delta. Twelve 2½ percent high-tension taps are available for operation by external no-load ratio adjusters to permit paralleling with the various substations on the system. A special calcium chloride breather is included to prevent entrance of moisture. High-tension and low-tension neutral bushings provide for grounded or ungrounded operation.

High-tension switching equipment consists simply of stick-operated fused disconnects for making and breaking paralleling currents and energizing or de-energizing the transformer. Various fuses are available for proper coordination at the different substations.

A line-type 5-kv. non-automatic oil switch is used for load switching on the low-tension side. A reel carries a 225-ft. length of three-conductor, rubber-insulated, extra-flexible, 4-kv. No. 2/0 tellurium rubber-jacketed, dredge-type cable with molded rubber terminals and a copper ground sheath serving as the neutral conductor. This cable is connected to live lines or buses by means of hot-wire devices.

The semi-trailer-tractor unit averages from 10 to 15 miles per hour on the over-all trips and requires only a few hours to be placed in service, including phasing and switching time. The substation has been in active service over half of the past six years, with an average usage of almost once a month on maintenance and construction jobs.

Since the accompanying illustration was made and because the legal limits for axles and gross weight were increased, the following items have been added: (1) Three 37-kv. line-type lightning arresters were installed near the high-tension bushings; (2) six 3-kv. line-type lightning arresters were installed on the low-tension side of the unit; (3) three 36 kva., single-phase induction feeder regulators. Originally the regulators were carried to the sites by a crane truck because the addition of the regulators increased the total weight of the combination on the road from 2 to nearly 25 tons.

*Second in a series of four articles which began in the July 10, 1943, issue of "Electrical World."

Extra Clamps Stop Oil Leakage

By N. J. GALUPPO
Transformer Repair Division, Indianapolis Power & Light Company

An idea developed by the transformer repair division of the Indianapolis Power & Light Company for making use of salvaged metal to prevent oil wastage, thereby effecting a double economy, is shown in the accompanying illustration.

In the older style transformers with pressed steel covers, only two clamping lugs were provided on the sides. When these are pulled tight the front and back of the covers are sufficiently loose to allow oil to spill through when the transformers are handled and moisture and dust to creep in after the transformers are mounted.

The oil spillage was found particularly undesirable when transformers

EXTRA clamping lugs added to front and rear of transformer cover at right reduce oil loss during handling

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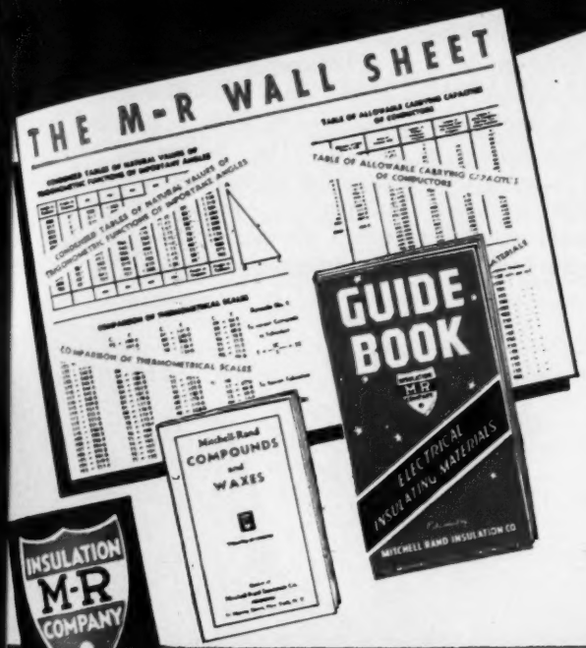

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Write today for your Free Card of Varnished Tubing with samples ranging from size 0 to 20 to fit wires from .032 to .325 inches . . . other valuable aids, are the M-R Guide Book of Electrical Insulation . . . the Wall Chart with reference tables, electrical symbols, allowable capacities of conductors, dielectric averages, thicknesses of insulating materials and tap drill sizes . . . and the M-R Wax and Compound Guide Book . . . they are full of valuable information . . .

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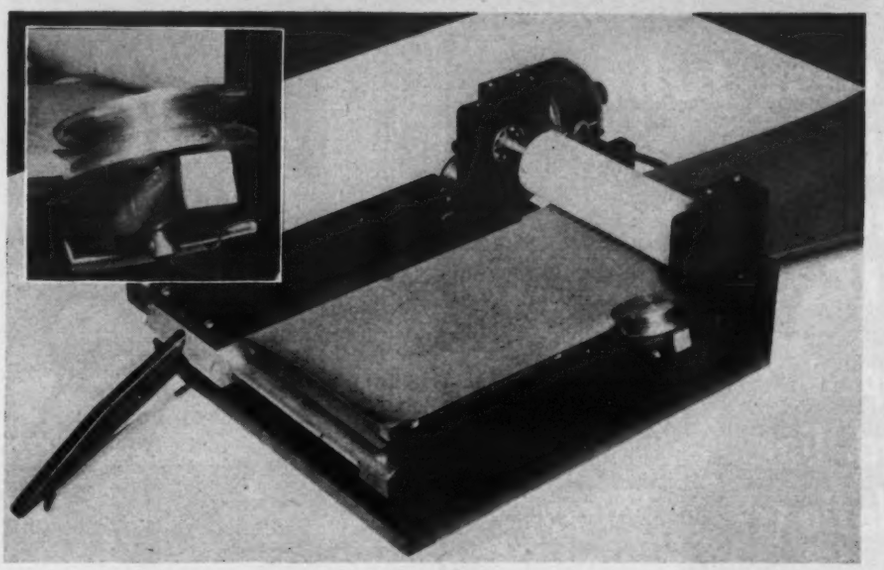


MACHINE for creasing and bending paper is driven by a small motor. Inset detail shows eccentric tension device on grooved wheel

were hauled and jolted on line trucks, but was eliminated by adding two extra clamps, made of material from the company's scrap pile, to each cover—one at the front and the other at the back, as shown on the transformer at the right in the illustration.

Such additional clamps are installed on all types of transformers having such lids, from ratings of 5 kva. to 150 kva.

•

Cuff-folding Paper Insulation Device

By L. G. WALKER
Assistant Engineer,
Idaho Power Company, Boise

The paper layer insulation in distribution transformers has a cuff folded along its edges, which varies from approximately $\frac{1}{8}$ to $\frac{1}{4}$ in. in width, and from one to four extra thicknesses of paper. Additional thickness of paper is obtained by folding the edge back and forth to form a compressed accordion pleat. A device to produce this fold of various widths on insulation from 1 in. to 6 in. wide was needed in our transformer repair department. Producing these folds by hand is not only a lengthy procedure but also not too satisfactory.

The device shown in the accompanying illustration uses a grooved wheel riding on a corresponding angular strip of metal to crease the paper sharply and bend it back to a small angle. The adjustable guide determines the amount to be folded under. Guide is slotted to keep the paper flat and true. Folding pressure is obtained through an eccentric shaft and spring, which holds the wheel against the angular edge. Drive is obtained with a pair of discarded wringer rolls which were revamped and coupled, through a worm drive, to a resurrected sewing machine motor.

After the paper is run through the first time, to crease it, a second run, with the fold up, completes the crease and flattens the edge. The guide is then shifted an amount equal to the cuff width and either an additional fold is made on the same side or a similar fold is made on the other side.

In practice, all the paper for a particular job is run through one fold, the guide reset, and another fold made on the entire batch. This continues until the folds are complete.

This may sound drawn out and time-wasting, but it still beats hand folding, with no comparison. If so many different paper and cuff widths were not involved, a device to complete all folding in one run could have been built, but it was considered better in this case to simplify the design, inasmuch as the quantity of paper to be folded was not excessive.

•

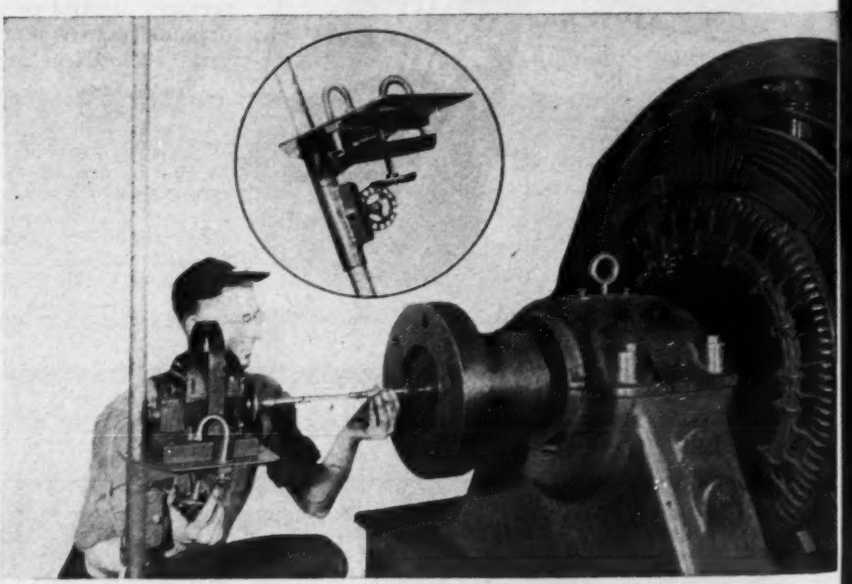
Adjustable Stand For Mounting Tachometers

By GEORGE SCHAFFER
Generator Division, Westinghouse Electric & Manufacturing Company, East Pittsburgh

In measuring the speed of a revolving shaft a tachometer is usually connected by means of a flexible coupling. The mounting of the instrument firmly and in proper alignment with the shaft sometimes presents a problem. An easily constructed stand helps to overcome this.

Stand is portable and has provision in its base for screwing to T-bolts mounted in the T-slots of the test floor plates. A platform for mounting the instrument slides up and down on the upright pipe, which is welded to the base of the stand.

Platform is adjusted to the proper height and then clamped tight by means of a screw wheel and a split sleeve. The tachometer itself is mounted on this platform and held in place by means of two J-bolts, which are pulled down through use of another screw wheel.



TACHOMETER mounted on an adjustable stand. (Inset) Platform and clamp.

6 good reasons

L-M HEAVY DUTY LIGHTNING ARRESTERS ARE PROTECTING MORE LINES THAN EVER BEFORE

1 HIGH SURGE CAPACITY

The special L-M valve composition will handle high-amperage and long-tail surges equally well.

2 LOW IMPEDANCE

Due to its characteristics, the L-M valve material holds internal resistance (IZ drop) to low values at all surge currents.

3 MOISTURE-PROOFNESS

Double "elastic" sealing at top and bottom, controlled production and thorough routine tests result in highest, permanent moisture-proofness.

4 PERMANENCE OF CHARACTERISTICS

L-M valve material is chemically and electrically absolutely stable, does not change its characteristics in operation, assures same unfailing operation, after years of performance.

5 VISUAL-INSPECTION GLASS BODIES

Glass bodies, exclusive with L-M Arresters (Pat. No. 2,165,964) permit easy inspection of Arrester condition at any time without costly laboratory or field tests.

6 THE ISOLATOR FOR FEEDER-LOCK-OUT PREVENTION

Any arrester might become damaged at some time in service. The L-M ISOLATOR will then save you time and money because it will automatically cut off the faulty arrester from the line, preventing feeder lock-out or phase grounding — Only L-M Arresters have the ISOLATOR. (Pat. 2,315,320).

Detailed information further explaining and illustrating these features and the reasons why they contribute to better service are fully covered in L-M Bulletin 40151. Write for it or ask your L-M representative for a copy.

LM

LINE MATERIAL COMPANY

HOW TO DETERMINE SAFE LOADS FOR SISAL ROPE

Substitution of sisal for manila rope introduces no new hazards if proper allowance is made for the difference in strength and probable service life. Accompanying information and data are adapted from Industrial Data Sheet No. D-Gen. 23 issued by the National Safety Council, Inc., Chicago, Ill.

1. Sisal fiber ranks second only to manila as an important raw material for the manufacture of fiber rope. Principal source of true sisal, known as *Agave sisalana*, is the Dutch East Indies, although considerable quantities are also grown in Africa and Central America. A somewhat poorer variety, *Agave fourcroydoes*, or henequen, is extensively grown in Mexico, but rope made from this fiber has only 65 percent, approximately, of the strength of the same size manila rope. This compares with 80 percent for the true sisal, to a detailed discussion of which this Data Sheet will be limited. Data on sisal rope were originally published by the National Safety Council in the belief that it would be available as a wartime substitute for manila fiber. However, both types of fibers are now equally scarce and are commercially available only on high wartime priorities. It is, therefore, essential that existing stocks of manila and sisal ropes be preserved in every possible way.

2. When new and clean, sisal fiber has a yellowish white color, occasionally tinged with green. It lacks the sheen and luster of new high-grade manila fiber. Sisal fibers are stiffer, somewhat harsher and possesses a tendency to splinter. Due to these characteristics, sisal rope feels somewhat rougher and coarser to the hands than does manila rope.

3. Good quality sisal rope has, as already stated, 80 percent of the strength of manila rope of corresponding size. Before purchasing and placing sisal rope into service, therefore, it is extremely important that this difference in strength be taken into account in determining the proper sizes. If sisal and manila ropes are in use in the same organization at the same time, one type should be clearly distinguished from the other by staining the ends with vegetable dyes. Some manufacturers weave in a distinguishing marker throughout the entire length of the rope.

4. The difference in strength may be adequately taken care of in any one of several ways, namely:

(a) By using rope of larger diameter so as to maintain the same factor of safety as was used for manila rope.

(b) By making the loads lighter, to accomplish the same objective.

(c) By increasing the number of parts in the tackle, where this is possible.

Safe Loads for Sisal Ropes

Rope Diameter in Inches (Approx.)	Safe Loads, pounds			
	Single-Leg Sling 90 (Vertical)	Double (Two-Leg) Slings. Angle with Horizontal.		
		60 Deg.	45 Deg.	30 Deg.
3/16 (6 yarns)	72	124	101	72
1/4 (6 yarns)	96	166	135	96
5/16 (9 yarns)	160	277	226	160
3/8 (12 yarns)	216	374	305	216
7/16 (15 yarns)	280	484	395	280
1/2 (21 yarns)	424	734	600	424
5/8	552	956	780	552
11/16	704	1,219	995	704
3/4	864	1,496	1,220	864
13/16	1,040	1,800	1,470	1,040
15/16	1,232	2,133	1,742	1,232
1	1,440	2,494	2,035	1,440
1 1/16	1,680	2,909	2,375	1,680
1 1/8	1,920	3,325	2,715	1,920
1 1/4	2,160	3,741	3,054	2,160
1 5/16	2,400	4,156	3,393	2,400
1 1/2	2,960	5,126	4,185	2,960
1 5/8	3,600	6,235	5,090	3,600
1 3/4	4,240	7,343	5,995	4,240
2	4,960	8,590	7,013	4,960
2 1/4	6,560	11,360	9,275	6,560
2 5/8	8,320	14,410	11,764	8,320
3	10,240	17,735	14,480	10,240
3 1/4	12,320	21,338	17,420	12,320
3 5/8	14,560	25,217	20,537	14,560
4	16,800	29,097	23,755	16,800

5. Sisal rope should not be used to lift loads of sharp materials, nor loads having sharp corners, unless direct contact is prevented by means of pads or boards. Similarly, the rope should not be bent around small diameter pulleys nor otherwise subjected to abrupt bending.

6. New ropes should be uncoiled by laying the coil on the floor with the inside end of the rope at the bottom. This end is then pulled up through the coil and a right laid rope should uncoil in a counter-clockwise direction. A left laid rope should uncoil in a clockwise direction. If the rope does not uncoil in the proper direction, the coil should be turned over and the end again pulled through, thus reversing the direction of uncoiling. This procedure will reduce the likelihood of kinking.

7. Coefficient of friction for wet sisal rope is slightly less than for wet manila rope. Therefore, where it is necessary to use wet sisal rope for snubbing loads, extra turns should be used around the post, capstan or other anchoring device.

8. A rope should never be stored in a wet or dirty condition. Sand and mud may be washed from a rope by flushing it with water flowing from a tap or hose. If a hose is used, the pressure should be kept low, otherwise sharp, gritty particles will be driven further into the rope, which they will cut and damage when it is placed under tension.

9. Subsequent to washing, the rope should be hung in loose coils and thoroughly dried at ordinary room or outdoor temperatures. It should then be coiled and stored in a dry place having good air circulation. Fiber rope should not be subjected to high temperatures either while in use or in storage.

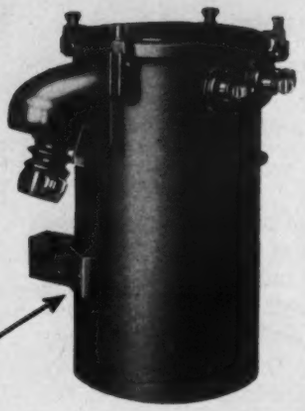
10. Rope should be inspected and tested at frequent intervals. Testing should always be done in such a manner that failure of the rope will not result in injury to any person or damage to other equipment. When ropes show evidence of cuts or damaged sections, such sections should be cut out and the rope spliced. Well-made short splices reduce the strength of the rope but 5 to 10 percent. A long splice will reduce the strength of the rope about 15 percent. When ropes show excessive wear, due allowance should be made for loss in strength, or they should be entirely discarded.

NOTE:—Safe loads given in the table are based on Federal Specification E-T-R-601A dated November 12, 1941, and February 9, 1942. A factor of safety of five has been used and this is the generally accepted minimum. On work where a higher factor of safety is customary or desirable, the tabular values should be reduced accordingly. For example, the safe loads based on a factor of safety of six are obtained by taking five-sixths of the values in the table; for a factor of safety of seven, five-sevenths, and so on.

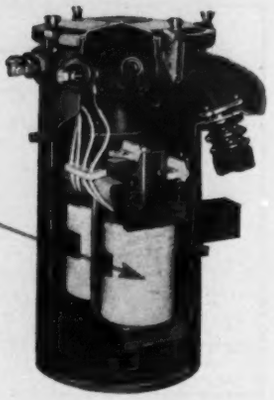
NOTE 2—For information on other types of fiber ropes, see National Safety Council Safe Practices Pamphlet No. 6, "Fiber Rope," and Industrial Data Sheet D-Gen. 3, "Safe Loads for Manila Rope Slings."

NOTE 3—Also see "Sisal Ropes Tested, Strength and Wear," ELECTRICAL WORLD, October 17, 1942, page 82.

from the outside the L-M ROUND-WOUND looks the same as other transformers...



but its PERFORMANCE cannot be duplicated!



Compare an L-M ROUND-WOUND Transformer with any other of equal rating. From the outside they look much the same — most transformers are built to E. E. I.-NEMA standards as far as bushing arrangement, mounting and other features of the tank are concerned — but there the similarity ends.

The L-M ROUND-WOUND gives you more desirable features than any other transformer. Higher short-time overload capacity, uniformly higher impulse strength and high mechanical resistance to short circuits are inherent advantages of this transformer.

It is natural that the ROUND-WOUND has higher short-time overload capacity. The two long, round coils readily dissipate heat because they are almost completely in contact with free oil.

Uniformly higher impulse strength is a result of the round shape of the coils. In winding, all sharp bends and strains in the wire are eliminated. Also eliminated, is the tapping mallet, which so often causes damage to the wire and insulation in conventional coil winding.

The L-M ROUND-WOUND is mechanically stronger to better withstand short circuit conditions without damage. Short circuits tend to form coils into a round shape. By having round coils to start with, the ROUND-WOUND is not subjected to the strains which short circuit conditions impose.

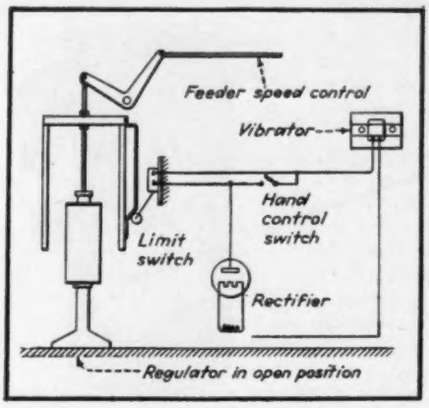
Regardless of the tank you put it in, the L-M ROUND-WOUND will still give you more desirable features than any other distribution transformer. ROUND-WOUND is available in 1½ to 25 Kva, 2400 to 7620 volt ratings.

LINE MATERIAL COMPANY

Coal Chutes Automatically Vibrated

By CLAUDE A. COX
Connecticut Light & Power Company,
Devon, Conn.

In the Devon plant boiler room the speed of feeders to each of four coal pulverizers is individually controlled directly from the pulverizer motor current. The desired current is established by a master controller, and any deviation from it causes a corresponding change in the feeder regulator



SCHEMATIC DIAGRAM of chute control at Devon station

position. In case of even a slight obstruction to the flow of coal the feeder speed regulator tends to go wide open. By means of a hatchway limit switch vibrators on the coal chutes are now started whenever the feeder speed regulator reaches 95 percent open.

Thus, when there is a stoppage in coal flow to the mill, the switch is automatically closed, the vibrator being immediately energized to reestablish a constant flow. Each set of scales and feeders has two vibrators, one above the scales and one below. Both vibrators are controlled by a switch on the control board (hand control). The vibrator above the scales has an automatic signal, but there was none on the one below. By connecting the vibrator below the scale for automatic operation by the feeder regulator complete protection is obtained against loss of a mill, and so against any reduction in generator capacity and cut in boiler efficiency. An obstruction that may cause the mill momentarily to empty to the extent of losing combustion at the burner, and a sudden charge of coal thereafter, may cause a serious puff and do considerable damage. With the above hook-up the warning gives the operator ample time to light the supplementary oil burner or shut down the mill.

•

Economy of 277-Volt Industrial Lighting

By R. H. KAUFMANN
Industrial Power Division,
General Electric Company

Substantial reductions in the qantity of critical materials required for supplying industrial factory lighting can be obtained through the use of 277/480-volt supply, using the recently announced 265-volt, four-lamp fluorescent lighting unit, to supply power and light. The material savings would amount to approximately 12 tons of copper and 30 tons of steel for a typical moderate size factory of 1,000,000 sq.ft. of working floor area with a total electrical load of 8,000–10,000 kva.

A specific comparison serves best to bring out the merits of the proposed system. A representative efficient unit load area of 350 x 350 ft. (125,000 sq.ft. approx.) is assumed, using 2 va./sq.ft. for fluorescent lighting and 6 va./sq.ft. for power. Each unit load area thus contains provision for 250 kva. in lighting and 750 kva. in power. In the accompanying diagram, energy supply is shown in three comparative methods: (1) Combination 277/480-volt light and power, (2) 480-volt power with stepdown to 120/208-volt lighting, (3) separate power and light feeds.

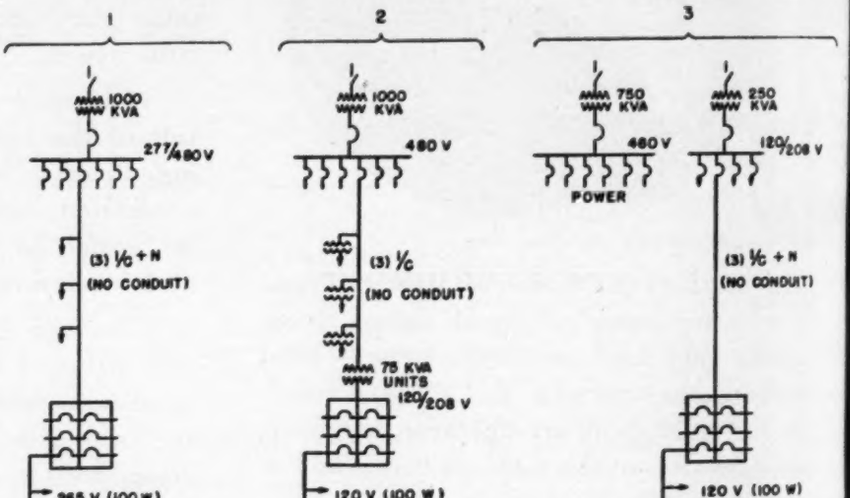
Since power feeder circuits are identical in all cases, they are not included in the present comparison.

Lighting-main feeders have been based on the use of moderate cross-section (No. 4/0) spaced single-conductor cables in air. This provides for high efficiency in the utilization of copper and steel. The use of less effective feeder construction would accentuate savings made possible by the proposed system. Branch lighting circuits have been based on two-wire operation at 15 amp. per circuit.

Relative requirements for cases 1, 2 and 3 are 100, 140 and 145 percent, respectively, in copper, and 100, 155 and 160 percent, respectively, in steel.

Sources of savings are in:

1. Fluorescent lamp ballasts—The 265-volt, four-lamp ballasts utilize material more effectively than available lower voltage equipment.
2. Transformers—A 1,000-kva. unit requires about 400 lb. less copper and 2,000 lb. less steel than a combination of two smaller units, one for power and another for lights.
3. Low-tension distribution circuits—

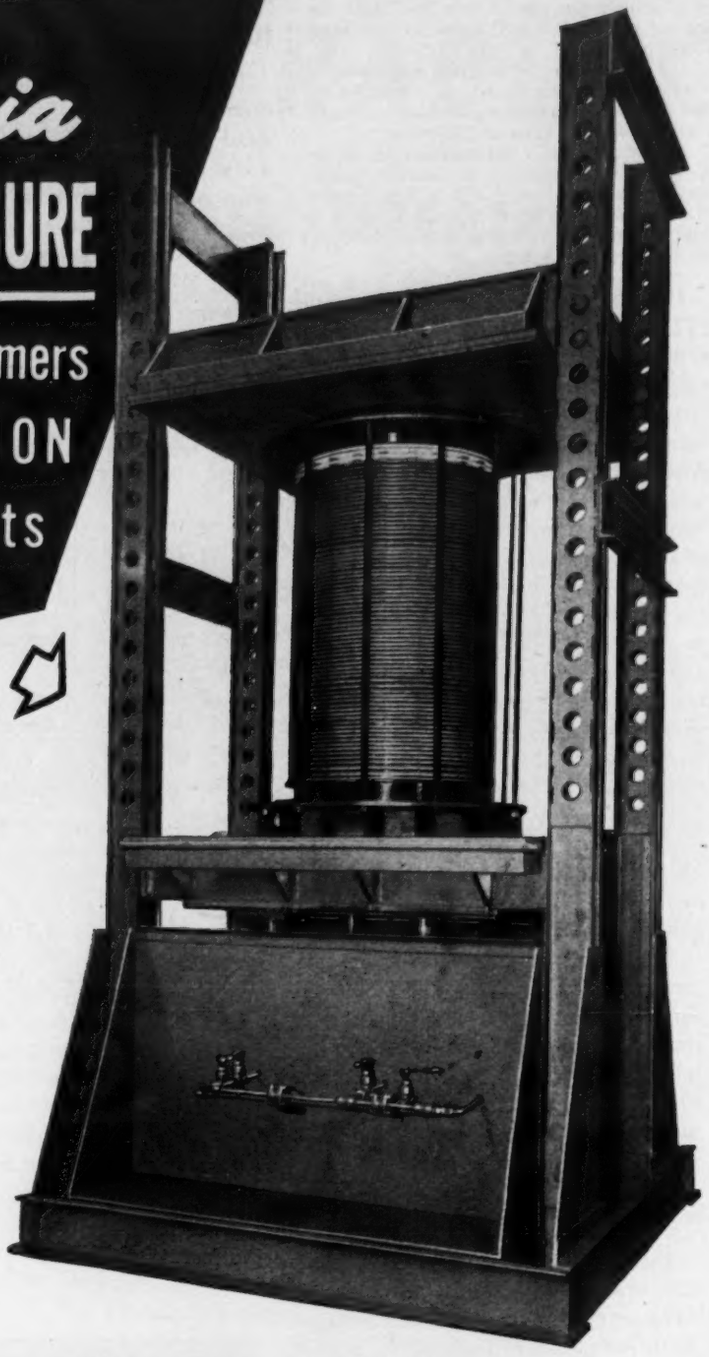


COMPARISON of copper and steel requirements for different methods of industrial energy supply

Note—There is now available a 208-volt, 40-watt, three-lamp ballast which is comparable with the 265-volt, 100-watt, four-lamp ballasts in material utilization. Its use in cases two and three would improve the over-all material investment to 130 and 135 percent copper and 140 and 145 percent steel respectively. While no advantage is obtained for factory application, its use in office areas, where the use of 120/208 volts is dictated by other considerations, would show attractive savings.

Pennsylvania PUTS ON THE PRESSURE

...to Give Your Transformers POSITIVE PROTECTION against short circuits



5000 Kva coil under 125,000 lbs. pressure. This hydraulic press capable of applying pressures up to 600,000 lbs.

helical and pancake coils pre-mpressed under pressures greater n short circuit stresses encountered service.

e ability of the coils to maintain their apes under the prescribed pressures finitely guarantees that the trans-mers will withstand short circuits.

re are the fundamental principles ed by PENNSYLVANIA in building nsformers to withstand short circuits.

DRYING The coils and all insulation must dried sufficiently to make sure that no inkage will take place when the transformer n operation or is under a short circuit.

PRE-COMPRESSING The dry coils must pre-compressed to such an extent that no her compression can take place under the st severe short circuit. This definitely cludes any possibility of the coil stack wing or distorting under short circuit.

TREATING After drying and pre-com-ssing, the coils must be treated in such a nner that they are self-supporting and will intain their pre-compressed and pre-shrunk pes when mounted on the core.

SUPPORTING The final step is to provide ficiently strong supports at the top and bottom the group of coils to keep the coils in their -compressed shapes.

★ ★ ★ ★

Pennsylvania TRANSFORMERS

Pennsylvania TRANSFORMER COMPANY

PITTSBURGH, PENNSYLVANIA

Operation of distribution circuits at 277 volts allows the use of less than half the copper required at 120 volts for the same electrical load.

4. Low-tension switching equipment—Feeder and branch circuit switching equipment is much more economical of material at 480 volts than at 208 volts.

5. Intermediate transformation—Intermediate transformation is entirely eliminated. In small ratings (50-75 kva.) material investment in such transformers is quite significant (roughly 6 lb. copper and 20 lb. steel per kva.)

Operation of lighting circuits with 277 volts, line-to-ground, represents a potential hazard which should receive careful consideration. Branch circuit switching equipment should incorporate high-quality, dead-front construction and energized conductors should be adequately confined to insure freedom from accidental contact by operating personnel. Electrical circuit maintenance should be performed only when the circuit is de-energized. This is not a serious matter since lighting circuits require very infrequent attention. Suitable insulated tools are available and should be used for lamp replacement while circuits are energized.

The proposed system is advocated principally for extensive factory areas in which lighting units are permanently located at a height at least 8 ft. above the working floor.

The use of common substations for power and light allows voltage variations resulting from motor starting or irregular or pulsating loads to be imposed on lighting circuits. To insure freedom from objectionable flicker effect in lights, certain simple precautions should be observed.

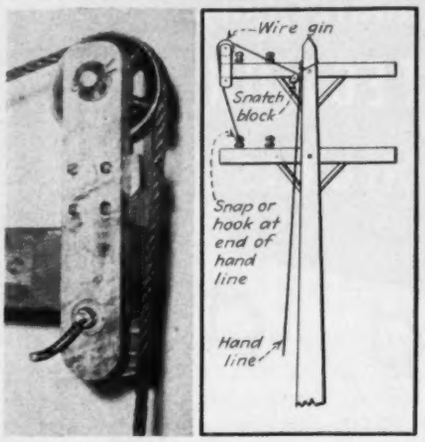
Separate Feeders

Independent circuits for lighting will eliminate the most troublesome source of fluctuating lighting voltage. With independent feeders, occasional across-the-line starting of a 100-hp. motor and frequent starting of 50-hp. motors can be permitted on a 1,000-kva. transformer unit. The permissible motor size which may be accepted will vary directly with the transformer rating.

Spot and stitch welder equipment can be responsible for aggravating light flicker. Unit welding machines with instantaneous demand not exceeding 100 kva. can be considered free of trouble on a 1,000-kva. transformer. An area which includes numerous miscellaneous, or a few large, welding machines, may justify a substation which serves no lighting.

Devise Wire Gin to Hoist Conductors

A simple fixture that eases the lineman's burden in transferring dead or energized conductors from a low to a high crossarm on the same pole or to an arm on a new and higher pole has been developed by the Wisconsin Electric Power Company, Milwaukee. The device, called a "wire gin," is shown herewith in



SHEAVE clamped to end of crossarm aids in transfer of conductors from lower to higher pole positions

working position on the end of a crossarm.

With the conductor covered with line hose, it has been the practice in the past for the lineman to stand under the conductors and hoist them, one at a time, on his shoulder to the roof of the pole and there hook them over lag screws driven in the pole top, until the new arm was installed; then tie in the conductors. With the conductors under tension, hoisting the wires is arduous, at best. The lag screw holes in the roof of the new pole led to rapid decay.

With the wire gin the job is easier. After the new arm has been installed a "snatch" block is fastened to the pole at the top crossarm and the gin clamped to the other end. A hand line, fastened to a conductor, is passed up over the pulley on the gin through the snatch block and down to ground. The wire is hoisted into place on top of the upper crossarm by the groundman.

•

Small Portable Power Plant for Standby

The Montana Power Company has a water storage reservoir at the head of the Madison River, formed by Hebgen Dam. This is 85 miles from any power service. A small waterwheel and generator were installed to provide power for operating the gates and for lights. There is always the possibility, however, that trouble with this plant may leave the company without any power whatever, so a "reserve" power plant is being built at the company shops in Butte, under the supervision of I. D. Hadzor, superintendent of shops.

The body of an old Buick sedan was removed and the 85-hp. motor, with transmission intact, was placed on the chassis so that a 600-volt d.c. generator, mounted toward the rear end, could be direct connected with the transmission. A governor will also be provided.

This portable power plant will be pulled as a trailer to the site and will provide sufficient current in an emergency to meet the limited requirements at the dam.

EIGHTY-FIVE-HORSEPOWER Buick motor and chassis can pack quite a load of kilowatts in an emergency

PHILCO VITRABLOC

. . . THE GREATEST CONTROL BATTERY NEWS IN YEARS!

EXCLUSIVE PHILCO FLOTÉ CONSTRUCTION

Among utility engineers, few battery developments have created such wide-spread interest and enthusiasm as Philco Vitrabloc. And it's understandable . . . this vitrified ceramic cell materially increases capacity of existing battery rooms! Explosion-proof and spray-proof, Philco Vitrabloc incorporates the famous Philco Floté element—the only construction specifically designed for modern, full float service! Philco Vitrabloc cells are now available on exceptionally low priority. Write for catalog giving complete engineering specifications.

PHILCO CORPORATION

STORAGE BATTERY DIVISION • TRENTON, NEW JERSEY

REPLACE WITH PHILCO BATTERIES

ARMY E NAVY

HOW TO INSTALL

A SINGLE-CONDUCTOR POTHEAD

Following procedure covers the installation of N.E.P.A. approved single conductor potheads and is adapted from the Underground Construction Standards of the New England Power System

1. PREPARING POTHEAD

A. Cut off cable entrance wiping sleeve to fit diameter of cable and file edge smooth.

B. With pothead completely assembled insert a piece of stiff wire through the cable entrance to the bottom of the soldering hole in the connector and mark wire even with bottom of wiping sleeve.

This gauge will be used in making final cut on the cable.

2. TRAINING CABLE

Place pothead temporarily in its final installed position. Train cable into position, avoiding all sharp bends and straighten it out from a point 6 in. below the wiping sleeve to 4 in. above top of porcelain bushing, at which point it should be cut off. Mark the lead sheath at the bottom of the wiping sleeve. Remove pothead.

3. PREPARING CABLE

A. Remove cable entrance wiping sleeve from pothead and slip on cable.

B. Cut the cable off at a distance from the mark equal to the gauge, Par. 1 b, measurement.

C. Score lead sheath 1 in. above mark and remove to end of cable.

D. Bind insulation with saturated flax twine at a distance from the end equal to the depth of soldering hole in connector plus ¼ in. Cut insulation at binding, square with conductor and remove to end of cable. See illustration.

4. ASSEMBLING POTHEAD ON CABLE

A. Sweat conductor into connector. Tape stem of connector to prevent solder sticking to threads.

B. Rebind insulation 1 in. from end, remove first binding and pencil insulation.

C. On cables operating at 10 kv. or over build stress cone of varnished cambric tape and copper tinsel braid as shown in illustration.

The copper tinsel braid should be spot soldered to the lead sheath at three or four places and also turns should be soldered together at various places to prevent unraveling.

D. Assemble pothead and cable and wipe cable entrance to sheath. This may be done in a horizontal position if means of support are available.

E. Bolt pothead in place.

5. COMPOUNDING

Proper filling of pothead with compound is very important and should be done with considerable care.

A. A ¾- or 1-in. filling pipe, long enough to extend above top of pothead, should be installed in the filling hole by means of a street ell. A pouring funnel will be placed in the top of the pipe.

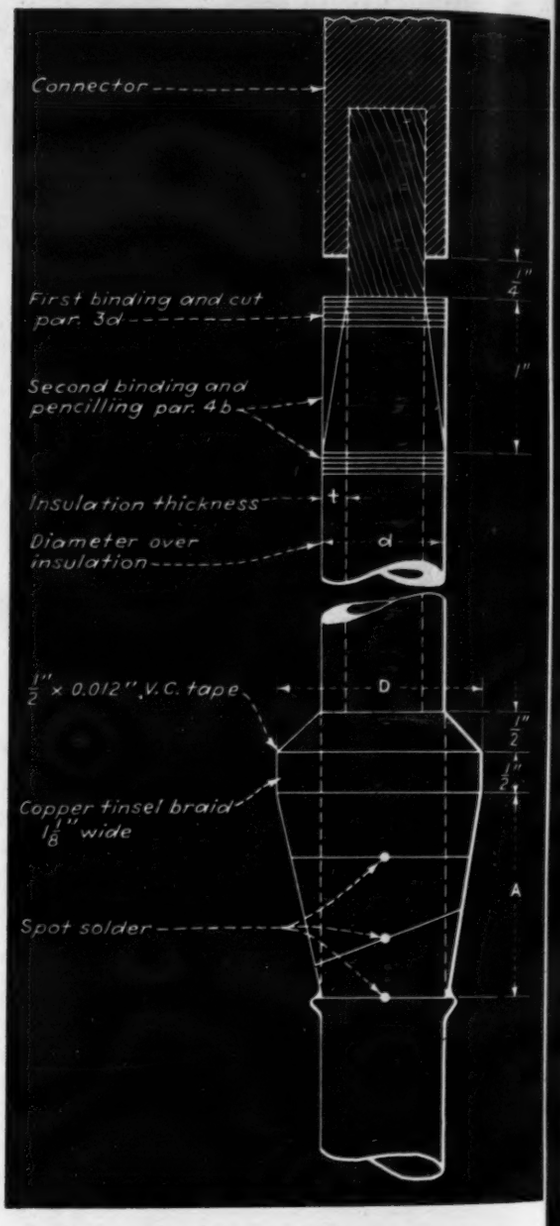
B. The compound should be heated to and maintained at its rated pouring temperature, a thermometer being used for control.

C. The pothead body should be warmed to prevent sudden chilling of the compound, which would cause voids. Do not apply heat directly to the porcelain.

D. Remove hood nut and pour compound through filling pipe until level is brought to top of porcelain, then continue pouring slowly until compound stops boiling and porcelain is solidly filled.

E. Replace and tighten hood nut. Let stand until pothead is reasonably cool, then remove filling pipe, replace and tighten plug.

F. Check tightness of hood nut and cable entrance wiping sleeve bolts.



PENCILING of insulation and stress cone. Diameter (D) of stress cone = diameter (d) over insulation plus twice the thickness (t) of the insulation. Length (A) of metal cone is as follows: for 10-15 kv., 2 in.; 15-25 kv., 2½ in.; 25-35 kv., 3 in.

HOW TO HELP "keep 'em firing" in your ELECTRICAL CONTROL army

It is DOUBLY important now to have some person in your plant definitely responsible for constant watch over electrical control apparatus. First, because the war effort must go on—without serious production delays. Second, because critical materials must be preserved—they are increasingly hard to replace . . . These fundamental inspection and maintenance pointers are available in printed card form. Write us for a supply. Post them where they may be useful.

INSPECTION

1. OVERLOAD? Check present installations to make sure increasing demands have not stepped up loads beyond the danger point.

2. PROTECTED? Check condition of fuses—heaters—circuit breakers. Make sure ratings are correct for present load carried.

3. WEAR? Check individual switch and control units for condition of contacts, wear of parts, freedom from dust and dirt.

4. SAFETY? Check condition of switch and control boxes—make sure interlocking safety devices are in operation and are being properly used. Replace faulty gaskets (on gasketed type enclosures). Be sure that the equipment is adequate to handle the requirements of the job.

5. OVERHEATING? Check location and load conditions of apparatus. Relocate where excessive ambient temperatures may cause trouble.

Be sure the circuit is dead before working on current carrying parts.

MAINTENANCE

1. OPERATE ALL SWITCHES AND CONTROLS PERIODICALLY. Allow none to become "forgotten".

2. CLEAN or "BLOW OFF" all apparatus—especially that in dusty or hazardous locations.

3. LUBRICATE REGULARLY and carefully, to prevent friction and wear and tear—do not over-lubricate.

4. REPLACE (promptly) PARTS that may be worn or imperfect—a minor part replaced may save major trouble.

5. CHECK WIRING CONNECTIONS FOR TIGHTNESS at all points of contact — terminal lugs, fuse contacts, etc. Keep screws tight.

6. CLEAN CONTACTS in accordance with instructions on inside covers and check for burning, pitting, and for proper alignment.

7. TEST handles, crossbars, blades, for correct engagement, alignment and operation.

8. PAINT boxes, conduits, etc. periodically to prevent rust or corrosion.

9. TAKE CARE of your maintenance before repairs are necessary.

NOTE: TRUMBULL apparatus is readily inspectable and, to a large extent, parts are replaceable *from the front.* Details of design make inspection and maintenance easier.

TRUMBULL

ELECTRICAL CONTROL APPARATUS

NOTE: Careful attention and inspection should be given to all electrical equipment, especially under war conditions where strain is severe and uninterrupted operation a vital necessity.

TRUMBULL ELECTRIC MANUFACTURING COMPANY • PLAINVILLE, CONN. • A GENERAL ELECTRIC ORGANIZATION

OTHER FACTORIES AT NORWOOD (CINN.) O. — SEATTLE — SAN FRANCISCO — LOS ANGELES

Opening a portable carbon dioxide fire extinguisher valve used to be a rather slow operation. First the portabel was set down; the valve handwheel was turned to the open position, the portable then picked up and the gas directed at the fire. Now, C-O-TWO has changed all that.

NEW SQUEEZ-GRIP SAVES GAS AND TIME

No need to set the extinguisher down to open a C-O-TWO Squeez-Grip valve; even while carrying the cylinder the valve is easily opened or closed. Nothing to do but squeeze the control lever, over the carrying handle. The valve is opened just as fast as you can close your hand. Fire is out in split seconds—there will be no damage to materials or equipment. Now more than ever, C-O-TWO is Safer because it's Faster.

C-O-TWO is a registered trademark and corporate name of this company. C-O-TWO is inspected and labeled by the Underwriters' Laboratories; approved by Factory Mutuals and the Bureau of Marine Inspection and Navigation. To be safe specify C-O-TWO.

C-O-TWO FIRE EQUIPMENT COMPANY

NEWARK, NEW JERSEY

Sales and Service in the Principal Cities of United States and Canada

Tower-to-Roof Line Terminal Design

Two parallel circuits of No. 4 stranded copper operated at 13.6 k serve as bus ties between a generati station and a major transmission su station. At the generating station e the line terminals originally occupi

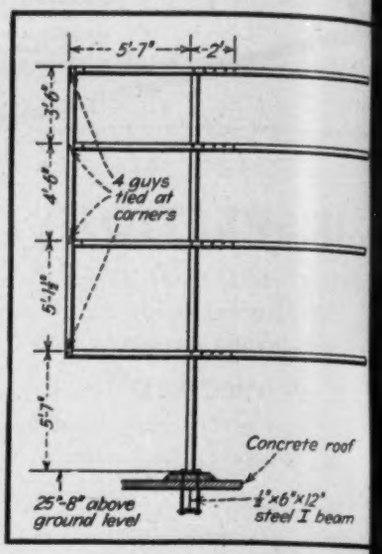


FIG. 1—Anchorage of strain structu members to footing on station roof

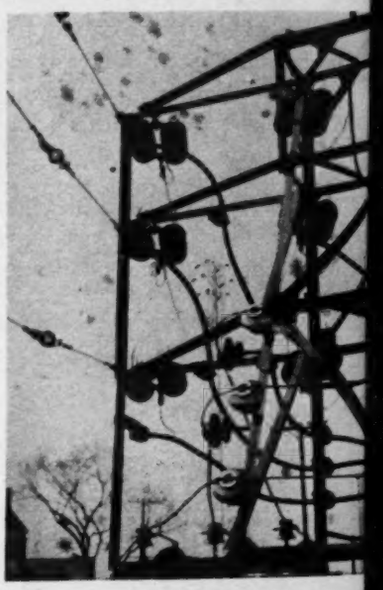


FIG. 2—View of terminal structure ex sion looking toward transmission towe

the first and second bays of a fou bay strain tower erected on the ro of an adjacent building. Recently became necessary to clear the grea part of the first bay and the enti portion of the second bay. To acco plish this an addition was built on t first bay extending outward beyo the edge of the roof where footi anchorage was impossible.

Why We Are Advertising Now

Surely, not to get more immediate business. Our entire facilities are devoted solely to the war effort. Our combined engineering experience and production ability is centered on one objective:... winning the war.

For decades the names Hendy, Pomona and Crocker-Wheeler have been familiar to you. That these names may be kept fresh in your mind until the war is won and we can again solicit your business, is the reason we're advertising now... telling you about our facilities, the products we're making, the personnel of the Hendy organization and such other things as we can publish without jeopardizing the war effort.

THE IRON MEN OF HENDY
...are now producing marine steam engines, steam turbines, and reduction gears; electric motors, fractional to 10,000 h.p.; generators, 3 to 7,500 KW; hydraulic pumps with capacities from 50 to 6 million gallons per hour... all exclusively for the war effort.

JOSHUA HENDY IRON WORKS

ESTABLISHED 1856

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CROCKER-WHEELER ELECTRIC MFG. CO

Manufacturing Plants: SUNNYVALE, LONG BEACH, POMONA and TORRANCE in CALIFORNIA • AMPERE, N. J. • ST. LOUIS, MO.
Branch Offices: NEW YORK • WASHINGTON • PHILADELPHIA PITTSBURGH • CHICAGO • ST. LOUIS • SAN FRANCISCO • LOS ANGELES

One-piece construction with no loose parts, and the fact that Fargo threads are always engaged, ready to tighten . . . these are Fargo Connector features that every lineman likes. They make it easy for even the less experienced lineman to do a neat job quickly.

And the skilled veteran, who knows his connectors, swears by the careful Fargo machining that makes the nut so easy to turn, and gives you the famed Fargo high pressure contact at low wrench torque...not just the first time, but after years of repeat use.

Made by FARGO MFG. CO.

Distributed by

LINE MATERIAL CO.
MILWAUKEE • WISCONSIN

The major members of the strain structure were of $\frac{3}{8}$ x $3\frac{1}{2}$ x $3\frac{1}{2}$-in. galvanized steel angle. Footings for each bay were at the corners of a 9-ft. square, each anchored to an I-beam supporting the roof as shown in Fig. 1. The rear portion of the structure slants upward toward the front and the whole is cross-braced with steel angles of smaller dimensions.

Eight pieces of $\frac{5}{16}$ x 3 x 3-in. galvanized steel angles were used to lengthen the horizontal members. An overlap of approximately 2 ft. was allowed. Each extension was secured with at least four $\frac{1}{2}$-in. bolts (see Fig. 1). The extensions of the front horizontal members were straight, but the rear extensions were bent forward and secured to the former about 10 in. from the end with pieces of $\frac{1}{2}$-in. galvanized steel plate which also served to receive the strain hooks of the insulator strings. A vertical member of the same type of steel angle was secured to the ends of the front extensions by means of $\frac{5}{8}$-in. bolts and ring nuts. A guy wire was fastened into each of these ring nuts and run back some 68 ft. to an anchorage fastened to a wooden roof truss (see Fig. 3).

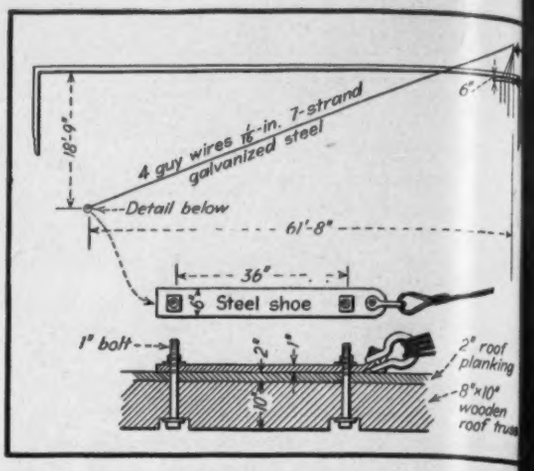


FIG. 3—Method of fastening guys to roof of station

Nearly all tension of one line w taken up by the strain guys. The s ond line was terminated on the corn upright of the first bay. The span the first steel tower has a horizon distance of 460 ft. and a differen of elevation of 135 ft.

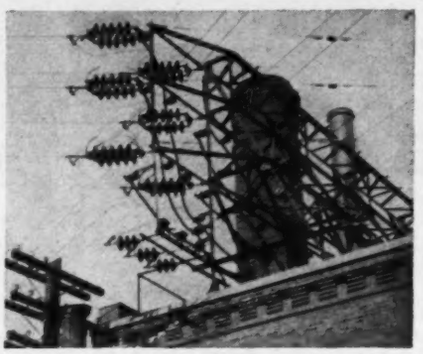
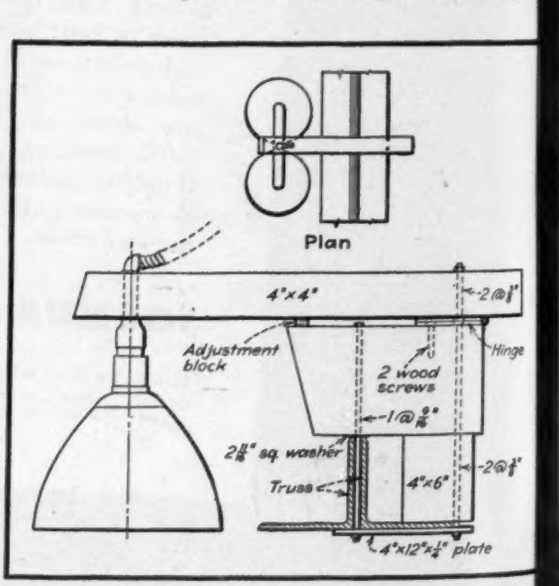


FIG. 4—Angular view of extension of terminal structure over station roof to clear adjacent property

Tip-Up Light Fixture Needs No Catwalk

By E. R. BONDS
Robert & Company, Inc., Atlanta, Ga.

Maintenance of lighting units fr overhead catwalks by means of so kind of tip-up fixture is becomi quite common in these days of lam hung high and illuminating wo congested floor areas of large exte This provision for maintenance h been incorporated by Robert & Co pany in several good-sized lighti

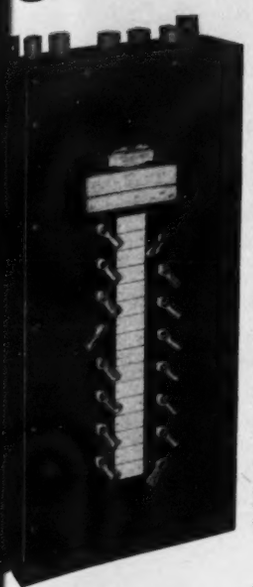


LIGHTING FIXTURE is set on bottom chord of roof tr

Dust-tight Panelboards are a MUST *in dust-laden atmospheres*

Guard against explosions that might be set off by exposed arcs. Play safe! Install

(FA) DUST-TIGHT PANELBOARDS



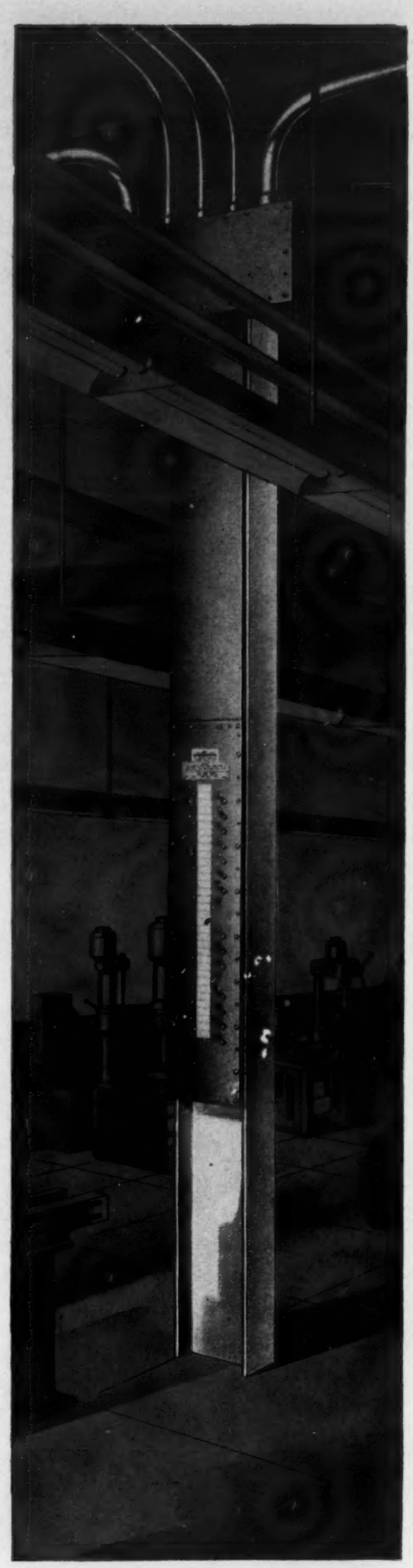
Above: Standard type (FA) Dust-tight Panelboard and cabinet for wall or exposed column mounting. (12" or 15" wide, as required.) At right: Column type (FA) Dust-tight Panelboard and cabinet, with wireduct and pull box. Ideal for 8", 9" or 10" H column mounting.

Underwriters' Laboratories, Inc., have approved them for "Class II, Groups F and G, Hazardous Locations." They are ideal equipment in atmospheres containing carbon black, coal or coke dust, or grain dust. In shell loading plants, coal mines, coal processing plants and grain mills, they are proving a vital protection.

Instead of the usual steel front with door, this panelboard has a solid steel front plate, gasketed all 'round, and secured with screws to the extra wide box flange. It is further rendered dust-tight with welded hubs for conduit outlets, welded box-corners, and handle bushings riveted directly to the steel cover plate. External mounting brackets are provided to maintain the dust-tight construction.

The circuits are externally operable by a mechanism of new (FA) design. The handles operate through dust-tight bushings, and engage the regular handles of the circuit breakers inside the cabinet. ON and OFF positions are indicated on the front of the cabinet.

The (FA) Dust-tight Panelboard may be had in standard type, or in narrow column type. It is of the circuit breaker type, with either the new (FA) Type AC Thermag or (FA) Dublbrak circuit breakers (or other types of lighting branch-circuit circuit breakers) . . . Capacities: 50 amperes or less, for 3 wire, single phase, or 4 wire, 3 phase mains, with lugs only. Available with 4 to 42 circuits . . . Frank Adam Electric Company, St. Louis, Mo.



EST. 1891 — THE SIGN OF A BETTER JOB

FA

Frank Adam

ELECTRICAL PRODUCTS

for War Industry

FRANK ADAM ELECTRIC CO. ST. LOUIS, MO. U.S.A.

(FA) Electrical Equipment includes: Busduct, Wire and Cable Duct, Service Equipment, Panelboards, Switchboards, Safety Switches, Knife Switches, Floor Boxes, Fan Hanger Outlets, and related equipment.

Designed to Outlast the Substation

HI-VOLTAGE

Type CW Air Break Switches

● Designed electrically and mechanically to provide more than just efficient performance—actually built to give life beyond the age of the substation. This Hi-Voltage CW Switch is attractive in appearance, involves low installation cost, offers ease of operation and unmatched dependability . . .

Closing—the switch arm swings to the horizontal position in alignment with the contact—moves endways through opening of contact housing into contact.

It is essential that a switch mechanism develops its most powerful leverages at the open and closed positions. Hi-Voltage accomplishes this with a completely housed linkage which controls the motion of the switch arm.

HI-VOLTAGE

EQUIPMENT COMPANY

2891 E. 79th St. • • • • CLEVELAND, OHIO

installations and from the experienc thus gained one fact stands out. It that catwalks for a large area run in quite a lot of money.

To avoid this expense, or at lea to reduce it as much as possible, th tip-up fixture arrangement shown the accompanying sketch was de signed for attachment to a double angle bottom chord of a roof trus The maintenance man walks—or per haps it would be more accurate t say he shuffles—along on the chor holding to a hand cable strung abou four feet up on the truss members. H is tied to the hand cable by a double safety belt so that he may step th two loops around points where th cable is fastened or where truss mem bers cross it.

The fixture consists of a 4 x 4-in piece of wood hinged to the top c two wood spacer blocks whose pur pose is to position the bottom edge o the reflector even with the bottom c the truss chord and which are fixe on the chord by bolts and a clam plate so as to avoid the necessity o drilling holes in the chord angl flange.

By the use of this fixture and th hand cable, lighting units are pos tioned at any desired spacing alon the length of the truss and movemen of the maintenance man from on truss to another is along a catwal which had to be provided for othe services.

•

Series Capacitors—Where Place? How Big

Protection*—VIII

By S. LUBIN
Engineer, REA Technical Standards Division

A. External Short-Circuit Protectio

If the maximum short-circuit cur rent is greater than I_P a protective de vice must be installed to by-pass th short-circuit current around the capac itor. Since this protective device mus act within the first two cycles follow ing the short circuit, it is evident tha no mechanical device is feasible. A gap which will limit the voltage acros the capacitor to 250 percent of it rated voltage is therefore recom mended. However, where the lin short-circuit protection is slow, som automatic switching arrangement ma

*This series began in the April 17, 1943, issue "Electrical World."

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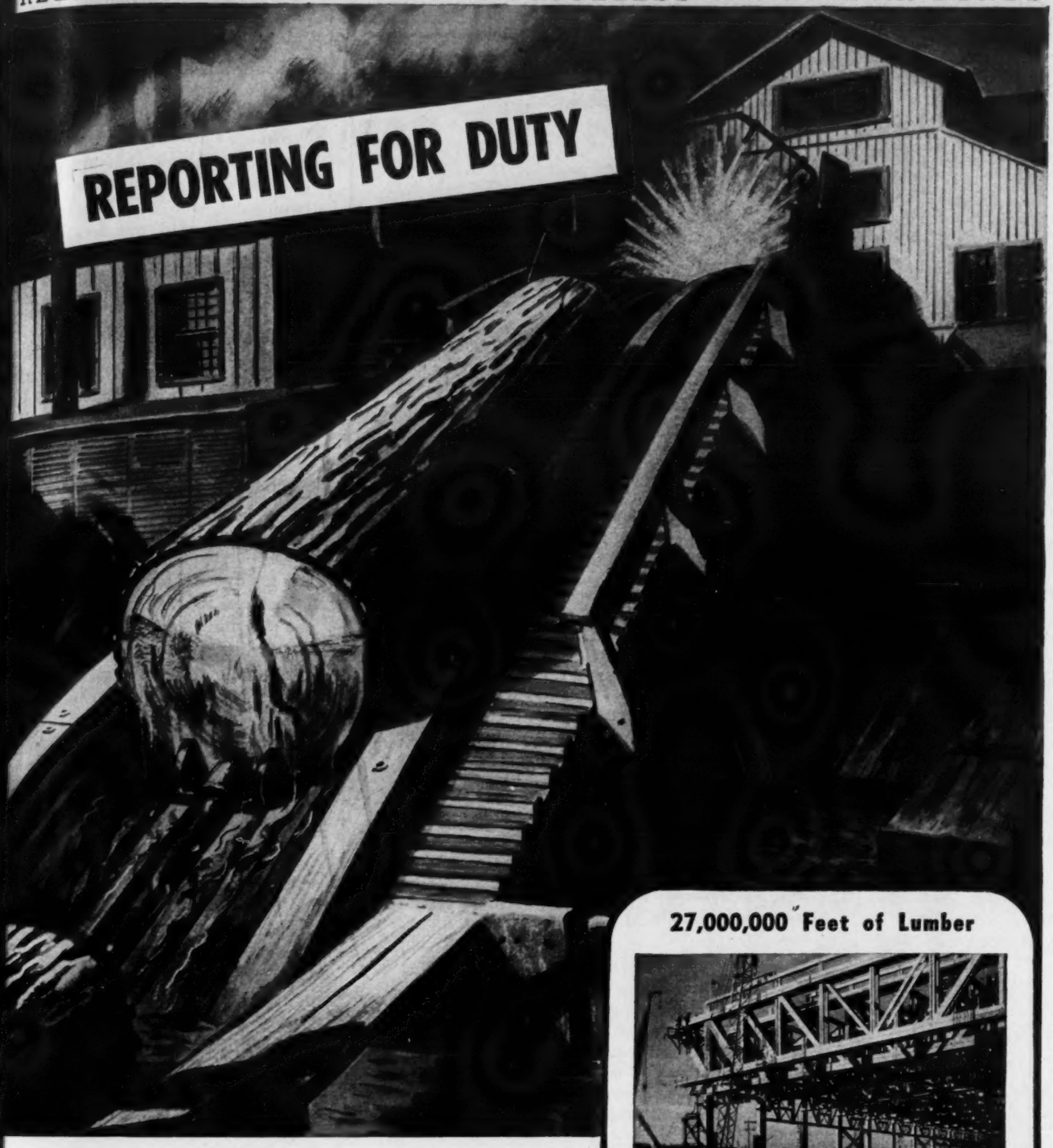

Up from the log pond into the sawmill. Wood is contributing to victory on every fighting front. At home, lumber prefabricated under the TECO Connector System of timber engineering has replaced metal in thousands of heavy war structures such as the aircraft assembly plant shown above. Engineered timber is destined to play a leading role in the reconstruction era to come. You, also, can design in timber with TECO—for strength, durability, and economy. Write today for our literature.

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NATIONAL MANUFACTURERS OF TECO TIMBER CONNECTORS AND TOOLS
WASHINGTON, D. C. PORTLAND, OREGON

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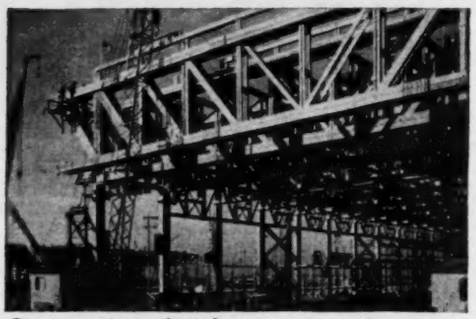
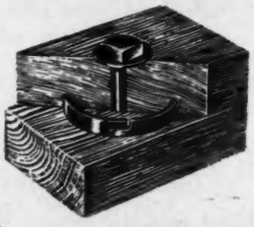


Giant, engineered timber trusses of the world's largest timber-built factory, designed by The Austin Company, of Chicago, engineers and builders.



The **TECO** Ring Connector spreads the load on a timber joint over practically the entire cross-section of the woods . . . brings the full structural strength of lumber into play.

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be necessary in conjunction with the gap in order to short out the capacitor after the first few cycles and for the duration of the short-circuit current flow, to prevent the gap from carrying the short-circuit current. When the ratio of system reactance to resistance is high, it is of major importance to provide this shorting equipment, since with the system reactance canceled out by the series capacitor the short-circuit current may exceed the rating of the sectionalizing devices on the line.

B. Internal Short-Circuit Protection

If the dielectric in the capacitor should break down, causing a short between the capacitor terminals, ordinarily no damage to line equipment would result and the line current would be unchanged provided no short to the grounded case occurred. However, where the capacitor is one of a bank on a multiphase line, continued operation of the bank with one capacitor shorted may cause failure of the other capacitors in the bank. It is, therefore, advisable to provide for automatic shunting out of the bank in case of an internal dielectric fault.

C. Lightning Protection

Where the capacitor case is insulated from ground no additional lightning protection is required, since the capacitor offers low impedance to high-frequency surges and is, consequently, self-protecting between terminals. Where the case is grounded or not mounted on insulators lightning arresters connected line-to-ground should be used for protection. Arresters should also be used on large capacitor installations with shorting equipment for overload protection.

•

Maintaining Level of Oil in Transformers

By S. BENNON
Transformer Engineer, Westinghouse Electric & Manufacturing Company, Sharon, Pa.

Reasons for maintaining a proper oil level in power transformers and a method for calculating the amount of oil to be added to maintain the oil level are presented.

In oil-immersed transformers the oil acts both as a cooling and insulating medium. All power transformers

Superior varnishing characteristics

1. complete impregnation
2. higher dielectric
3. with less varnish build-up
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Mobile communications units assembled by Hallicrafters are helping to win the battle of communications on every fighting front. They are built to endure the rigors of modern warfare . . . The consistent performance of SCR-299 has been highly praised by leading members of our armed forces for its adaptability in meeting all the requirements of combat duty . . . A phrase best describing the SCR-299 was given when a leading military authority said, "It is to communications what the jeep is to transportation."

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THE WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF SHORT WAVE RADIO COMMUNICATIONS EQUIPMENT

should have an oil level gage in ope ating condition at all times, prefe ably with alarm contacts. A regul check of the oil level is essential fro both the electrical and the therm point of view.

Electrically, the low oil level ma expose live parts designed for opera tion under oil, thus causing direc electrical failures. Thermally, a lo oil level may cause an increase i operating temperature, with an a companying increase in the rate o insulation deterioration. In a sel cooled transformer this would resu when the oil is below the top radiato openings; thus the oil must heat u until it reaches a level sufficient t produce circulation through the radi ators. In a water-cooled transforme it would be caused by low oil leve leaving parts of the cooling coil ex posed.

Temperature Range

Most power transformers are de signed to operate within a limited o temperature range, usually betwee —5 C. and 80 C. If the oil tempera ture falls much below —5 C. it ma be necessary to add oil to bring u the level, then to remove the exce oil when the temperature rises. I the additional breathing is not objec tionable, the excess oil may be left i the transformer.

In filling the transformer with o it should be remembered that th number of gallons of oil stamped o the metal instruction plate is base on an oil temperature of approxi mately 25 C. For oil temperature that are considerably different a cor rection should be made for the coeffi cient of expansion of the oil, whic is approximately 0.000733 per deg C. at 25 C. For example, if the name plate called for 10,000 gal. of oil a 25C. and the tank was being fille with oil at 37 C. somewhat more tha 10,000 gal. would be required to giv a volume of 10,000 gal. after the oi had cooled to 25 C.

For this particular case we woul have:

Additional oil required = (10,000) × (37—25) × (0.00073) = 88 gal.
Total oil required = 10,000 + 88 = 10,088 gal.

The 25 C. marking on the magneti oil gage may be used as a secondary check. The gage should read above on or below the 25 C. marking whe the oil temperature is above, equal t or less than 25 C.

Before
THREE 3-POLE CIRCUITS AND OBSOLETE OPEN TYPE MAIN SWITCH
After
TWELVE 3-POLE CIRCUITS AND PROVISION FOR TEN ADDITIONAL . . . SAME BOX, SAME CONDUIT

Here is the easy, economical way to provide for increased power demands

● Increased production has brought the demand for more power distribution in scores of plants. There are countless fusible panels similar to the one shown at the left above—inadequate and subject to excessive heating.

Notice how easy it is to convert to a compact, dead front circuit breaker panel. Notice, too, that by utilizing thin wall wire, additional circuits have been provided, using existing box and conduit.

Your nearest Square D Field Engineer will be glad to work with you in determining your exact requirements for speedy, economical conversion.

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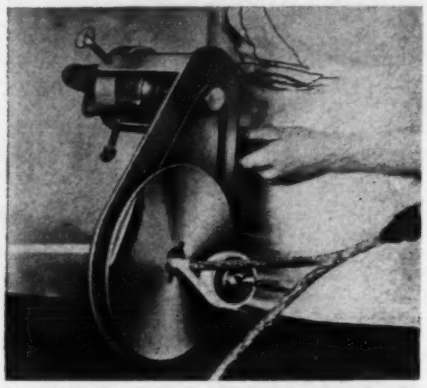
NEW EQUIPMENT

Tape Winder

Portable cable tape winder is a tool which can be used with a portable electric drill to tape a comparatively long cable, or plurality of cables into a single unit,



Cable tape winder; adaptable to different sizes of cables. **Leathem D. Smith Shipbuilding Co.**, Sturgeon Bay, Wis.

at the bench or on the job during construction. Operator holds the handle of the drill in one hand and the handle of the winder in the other hand. Taping is visible during the operation.

•

Rubber Substitute

"Kem-Pol" group. **Sherwin-Williams Co.**, Chicago, Ill.

Four types of rubber substitute made from vegetable oils are said to have among their uses: mats, braided tubing, gaskets, tapes, sealing compounds and cements. Kem-Pol No. 14 is a viscous liquid intended as an adhesive. No. 54 is a viscous, tacky, semi-solid gel-like material and may be cured. No. 11 is the most viscous of the untreated polymers, can be emulsified and may be used in preparation of mill stocks. Kem-Pol No. 11-41 MP is a dry sheet with only a slight tack and may be worked on a rubber mill, without pretreatment.

•

Rectifiers

Model "M" series Rectodyne rectifiers; capacities up to 1,500 watts and 6, 12, 24, 32, 64, 96, 128 and 144 volts d.c.; for single and three-phase supply. **McColpin-Christie Corp., Ltd.**, 4920 South Figueroa St., Los Angeles, 37, Calif.

Medium-capacity industrial electrical rectifiers are an addition to the manufacturer's line. They have the dry-disk type of element and an insulated secondary winding. Output can be adjusted by a rotary tap-changing switch connected in the primary circuit. Thermal overload protection and a motor-driven fan for ventilation are furnished. In addition to the stationary models a portable unit mounted on 8-in. rubber-tired wheels can also be obtained.

•

Tracing Cloth

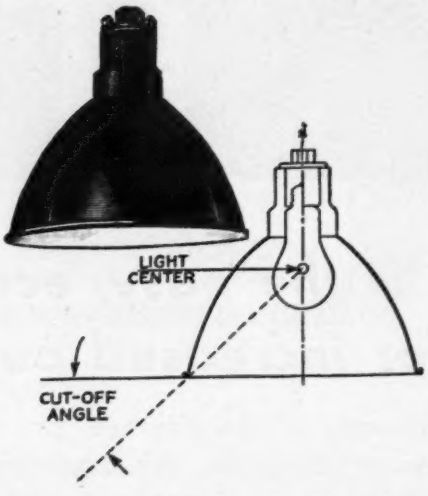
"Whitex" tracing cloth. **Frederick Post Co.**, Box 803, Chicago, Ill.

A recently developed white pencil tracing cloth is said to be moisture resistant on both sides. This feature, the manufacturer claims, is a safeguard against spots from perspiration or moist hands and against climatic conditions.

•

Reflector

Designed to confine and direct light rays on work, to prevent light losses and to reduce light leakage outside plants and



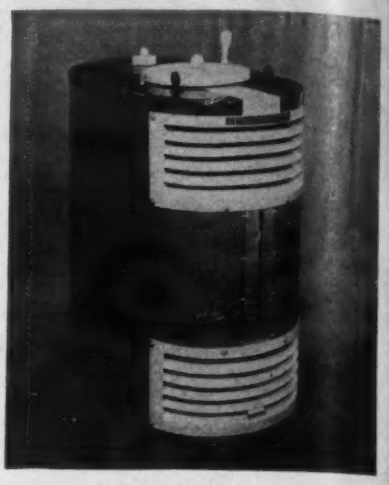
"Deep Bowl" reflector; four sizes, 7½, 10½, 15 and 17½ in. diameter. **Steber Mfg. Co.**, 2451 N. Sacramento Ave., Chicago, Ill.

barracks in dimout areas, new reflector has light center well inside. Shade holder types are made in several sizes for use with 60- to 200-watt lamps, and detachable socket types for use with 60- to 1,500-watt lamps.

BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

Welder

Designed for use in shipyards or other outdoor locations where exposure to the weather is encountered, new 500-amp. welder has "idlematic" control, which is



Outdoor a.c. welder; welding current range, 100—625 amp. at 40 volts. **General Electric Co.**, Schenectady, N. Y.

said to reduce automatically output voltage to less than 35 volts whenever the arc is not in operation, but provides full power for welding the instant the arc is struck. Control also includes a switch for starting or stopping the welder manually. Unit is provided with fingertip adjustment, stepless current control, fan-forced ventilation and capacity for operation with long leads.

•

Multimeter

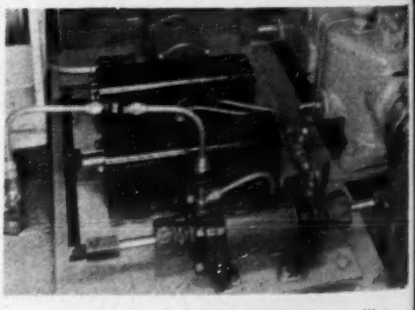
"Model 442" multimeter; four d.c. milliammeter ranges, 0—0.3/6/30/150; four d.c. voltmeter ranges, 0—6/150/300/1500; four a.c. voltmeter ranges, 0—6/30/150/600; four decibel ranges, —6 to +50 db. **Radio City Products, Inc.**, 127 West 26th St., New York, N. Y.

Pocket size instrument has been designed for multitest purposes, has a 200-microampere movement and a sensitivity of 5,000 ohms per volt, it is claimed.

•

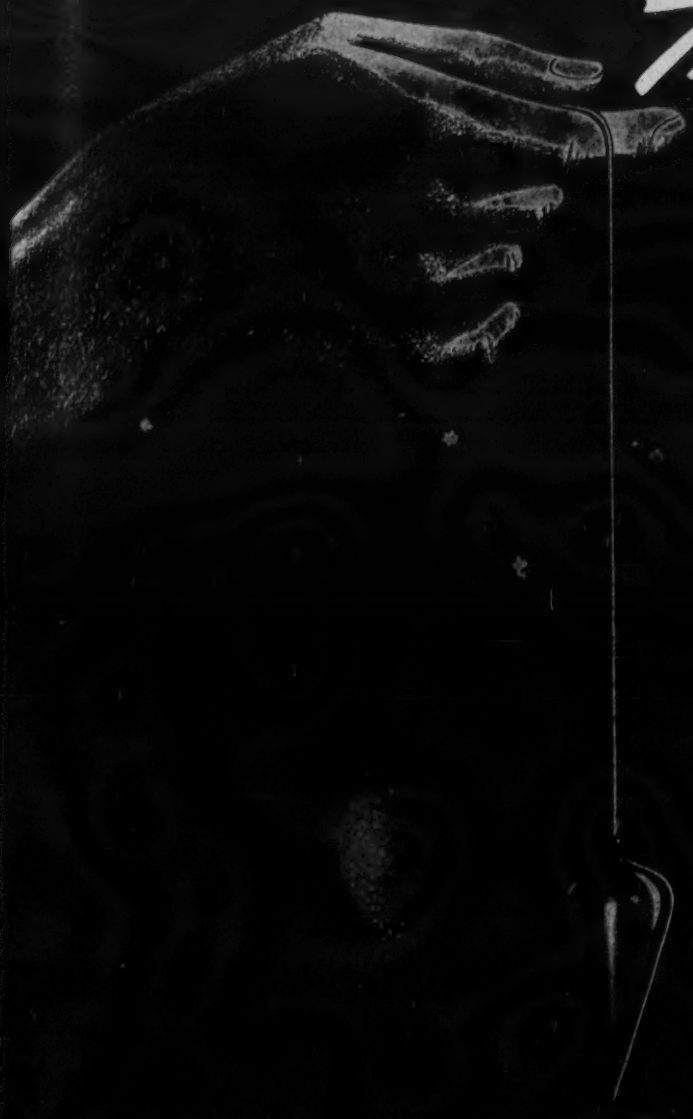
Remote Transmitter

Control device combines a Selsyn with a hydraulic jet pipe. The Selsyn movement need merely operate the sensitive jet pipe which is said to be practically frictionless and thus transmit the original impulse through a hydraulic system with sufficient power to operate heavy dampers, butterfly valves or any other equipment requiring accurate remote operation.



Remote electro-hydraulic transmitter; illustrated, hydraulic piston (front center), jet pipe and oscillating arms (inclosures), and Selsyn receiver (rear). Selsyn transmitter at remote location. **Askania Regulator Co.**, 1603 South Michigan Ave., Chicago, Ill.

Significant of Things to Come



HUBBARD

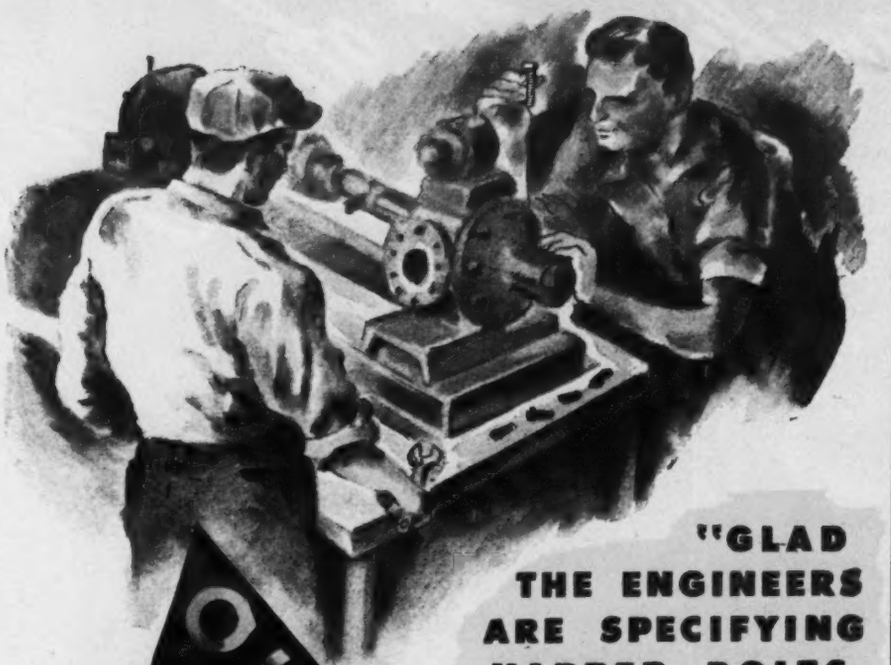
On this spot may stand a transmission tower — a gun emplacement or new factory. It is the preliminary step to events of the future. It is symbolic of the state in which many of your suppliers find themselves at this time; going over the top on war production but with an eye cocked on the future.

Most of the men and machines of the three Hubbard factories have gone into vital war production, but the plumb bob is swinging, settling down to mark a spot for future development. New designs of Pole Line Hardware are coming. New equipment is being readied to test new principles.

Big things are "in the making". Watch for them, and in the meantime; "Maintain that load on Hubbard Hardware."

HUBBARD AND COMPANY

PITTSBURGH . . . OAKLAND CALIFORNIA . . . CHICAGO



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"Harper Bolts don't rust. They're tough and they'll make this pump last a lot longer."

Yes . . . the non-ferrous and stainless fastenings made by Harper are adding extra toughness and extra service-life to vital parts of ships, tanks, jeeps, planes and other war equipment. Also in hundreds of war production jobs they are preventing failures of vital equipment and keeping production rolling. They have high tensile strength; they resist rust, corrosion, many acids and alkalies and other tough conditions.

4320 STOCK ITEMS . . . of bolts, nuts, screws, washers, rivets and accessories in the non-ferrous and stainless alloys.

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TECHNICAL LITERATURE

"MAINTENANCE of First Aid Fire-Fighting Equipment" discusses inspection, upkeep, charging, discharging and recharging of vaporizing-liquid, soda-acid, foam, anti-freeze and carbon-dioxide extinguishers. Included charts give data in condensed form as to extinguisher and engine characteristics, methods of operation, capacity, range of stream, etc. Copy of the illustrated booklet may be obtained from American-LaFrance-Foamite Corp., Elmira, N. Y.

SYNTHETIC RUBBER—"The Five Commercial Types of Synthetic Rubber" contains a discussion of various terms, a glossary, a chart giving the relative physical and chemical properties of natural rubber and the five types of synthetic rubber—Buna-S, Buna-N, Neoprene, Butyl, and Thiokol; as well as tracing the developments of each. The booklet is made available by the United States Rubber Co., Synthetic Rubber Division, 1230 Sixth Ave., New York, N. Y.

BRAZING—An instructional bulletin "Design" gives information regarding design of low temperature silver alloy brazed joints. Copy is available from Handy & Harmon, 82 Fulton St., New York, N. Y.

"HANDBOOK FOR THE WELDING AND CUTTING OPERATOR" contains a list of concise "Do's and Don'ts" as well as other helpful suggestions on the care and maintenance of blowpipes, regulators, and welding and cutting accessories. Copy may be obtained from International Acetylene Association, 30 East 42d St., New York, N. Y.

PORCELAIN—Common construction details and Surfolet wiring are outlined in "Installation Manual and Data Book on Porcelain Protected Wiring Systems" obtainable from Illinois Electric Porcelain Co., Macomb, Ill.

CABLE—"War Emergency Methods As Applied to Power Cables" is Research Laboratory Publication No. 102, available from the Okonite Company, Passaic, N. J., listing maximum copper temperatures for different conditions of loading of impregnated paper (solid type) insulated cable, varnished cambric insulated cable and rubber insulated cable; also a method for calculating the emergency load current on a cable.

LIGNUM-VITAE—Characteristics of the hard resinous wood and the purposes for which it has been and is being used is outlined in "Wartime Report on Lignum-Vitae" obtainable from Lignum-Vitae Products Corp., 100 Boyd Ave., Jersey City, N. J.

ELECTRODES—Chart details the principal A.W.S. and A.S.T.M. electrode classifications and indicates which electrodes produced by 20 leading manufacturers meet the different requirements. Copies of "Comparative Index of Welding Electrodes" may be secured by writing to Mr. G. Van Alstyne, Air Reduction, 60 East 42d St., New York, N. Y.

OVENS—"Blueprint for Industry" is the title of an 18-page booklet of engineering information on convection heated ovens and materials handling equipment for batch and continuous heating processes used principally in armament production. Copy may be obtained from Industrial Oven Engineering Co., 11621 Detroit Ave., Cleveland, Ohio.

HIGH-ALTITUDE BRUSHES

. . . another Stackpole Engineering Achievement

Brush problems increase tremendously with altitude—and it has remained for Stackpole to overcome these by producing the first really outstanding brushes for high altitude performance. These brushes are treated with a special process developed by the Westinghouse Electric and Manufacturing Co., and have resulted in greatly increased brush life for high-altitude flying.

Such progress is not accidental. It is the natural result of long years of leadership in producing better brushes for all conditions of use.

So rapid have been Stackpole developments in brushes for many kinds of rotating equipment that, whatever your requirements, it pays to check them regularly against the latest types this advanced engineering may have to offer.

(Stackpole Brushes are sold only to manufacturers of original equipment. Replacements can be obtained from the original equipment manufacturers.)

STACKPOLE CARBON COMPANY, ST. MARYS, PA.

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Metal, Carbon, Graphite and Composition Contacts • Anodes • Electrodes • Brazing Blocks • Bearings • Pipe • Welding Rods, Electrodes, and Plates • Packing, Piston, and Seal Rings • Rheostat Plates and Discs • Resistors, etc.

STACKPOLE *Brushes*

CARBON
CARBON-GRAPHITE
SILVER-GRAPHITE

FOR ALL TYPES OF
ROTATING EQUIPMENT

ELECTRO-GRAPHITE
COPPER-GRAPHITE
METAL COMPOSITION, ETC.

NEWS ABOUT PEOPLE

North Central Utilities Elect Gamble Head

Frederick R. Gamble, treasurer of the Montana-Dakota Utilities Co., Minneapolis, was elected president of the North Central Electric Association at

Underwood & Underwood

F. R. Gamble

the recent annual meeting. R. F. Pulver, sales manager, Minnesota Power & Light Co., Duluth, was elected vice-president and J. A. Hennessy, Northern States Power Co., Minneapolis, was elected treasurer.

Mr. Gamble has been identified with the electric utilities industry since 1921. Prior to his association with the utility industry, he was engaged in cost accounting. Following World War I, he joined the Electric Bond & Share organization at the time the Minnesota Power & Light Co. was organized. In 1925 he joined Montana-Dakota Utilities Co. and has been with the company continuously since that time. Mr. Gamble has been a member of the executive committee of the North Central Electric Association for the past ten years.

•

▶ CHARLES E. OAKES, president of the Birmingham Electric Co., has been appointed chairman of the Birmingham Committee for Economic Development. A business men's organization with sound post-war economics as its goal, the committee is organizing chapters throughout the country within regions corresponding to those of the Federal Reserve System.

•

Holophane Announces New Staff Promotions

Clarence C. Keller, assistant sales manager of the Holophane Co., Inc., New York, since 1934, has been appointed sales manager of the company. Following graduation from Ohio State University in 1929, Mr. Keller started in the engineering department of the company and until 1930 he worked continuously at the Holophane plant in Newark, Ohio. In 1932 he took charge of the commercial engineering department in New York, the position he held until his appointment as assistant sales manager. For some years he has been active in the Illuminating Engineering Society, having served on such varied committees as progress, light and architecture, membership, board of examiners, lighting data sheets and

C. C. Keller

local activities. In addition, he has been secretary of the New York section and most recently and currently vice-president of the Northeastern region.

Simultaneously, Davis H. Tuck, formerly electrical engineer, has been appointed chief electrical engineer.

The following district sales engineers have been appointed district managers in their respective territories: James A. Toohey, working out of Chicago; H. R. Thompson, Cincinnati; E. H. Grieb, Milwaukee; Judd Lough, Atlanta; C. A. Patterson, Oklahoma City; Carl Gershanick, Philadelphia; Jack Parks, Detroit; R. G. Dummel, San Francisco and Frank Van Gilluwe, Los Angeles.

•

Alan Brown New Head of Canadian Group

Alan Brown, who was elected president of the Canadian Electrical Association at the recent annual convention at the Seigniory Club, Quebec (ELECTRICAL WORLD, June 26, page 59), is manager of the eastern distribution district of the Gatineau Power Co., Ottawa.

Castongray

Mr. Brown was graduated in 1923 from Queen's University, Kingston, Ont., following overseas service with the Canadian Field Artillery in the First World War. He is a member of the Engineering Institute of Canada.

•

▶ H. H. KUHN, vice-president of the Kansas City Power & Light Co., has been elected president of the Missouri Valley Electric Association for 1943-44.

▶ WILLIAM W. FORMAN has been appointed assistant general superintendent of the Connecticut Light & Power Co., with headquarters at Waterbury. He is a graduate of Stevens Institute of Technology and entered the public utility field in 1923 as junior engineer of construction and plant operation for the Adirondack Power & Light Co. In 1925 he joined the staff of W. A. Shoudy, construction organization, New

This Nicopress SUSPENSION DEAD END

Is Speedily Installed And Assures STRONG DEPENDABLE LINE TERMINATIONS

Practically, Economically, Mechanically and Electrically Nicopress Suspension Dead-Ends are unsurpassed for making terminations on distribution lines.

They are designed for use with disc insulators and for neutral conductors attached directly to eyebolts. They are strongly made—assembled all in one unit for convenience in handling—and provide for a tail of any desired length. With them any lineman (using the same Nicopress Compression Tool used in making line joints) will speedily make neat, tight, trouble-free Dead-Ends that will last as long as the line. One very important advantageous feature of Nicopress Suspension Dead-Ends is that in making the dead-end the conductors go straight through the sleeve without bending or distortion. This feature assures maximum strength of the completed terminations and increases to a remarkable degree the power of the dead-end to withstand the strains of vibration. Because of their many time and labor saving features plus their exceptional strength, endurance and security you'll find Nicopress Suspension Dead-Ends the most satisfactory method of Dead-Ending.

The above illustration shows how very easy it is to make line terminations with Nicopress Suspension Dead-Ends and the convenient-to-handle Nicopress Tool.

ORDER THEM FROM YOUR JOBBER.

THE NATIONAL TELEPHONE SUPPLY COMPANY

Manufacturer of Specialties for Power and Communication Lines

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Canadian Mfr.—N. SLATER CO., LTD., HAMILTON, ONT., CANADA

Export Distributor—INTERNATIONAL STANDARD ELECTRIC CORP., NEW YORK, N. Y.

G-E FUSES
TO PROTECT ALL CIRCUITS

These are the same fuses General Electric uses to protect its own circuits. They provide reliable overload and short circuit protection. They are made of the finest materials and are thoroughly tested and accurately rated.

G-E Silvend fuses with silver-plated contacts are designed for use with apparatus having silver-plated fuse contacts. *Heating due to oxidation does not occur with this combination.*

For further information, see the nearest G-E Merchandise Distributor or write to Section D731-9, Appliance and Merchandise Department, General Electric Company, Bridgeport, Conn.

G-E non-renewable enclosed fuses, G-E renewable enclosed fuses, G-E Silvend fuses with silver-plated contacts — rated up to 600 amp. 250 V. or 600 V.

GENERAL ELECTRIC

JAMES KNIGHTS *Crystals*

When the new developments of this emergency period are available, and you re-equip completely with modern communications systems, remember that you cannot buy better crystals than those produced by The James Knights Co. The men of The James Knights Co. are pioneers in the radio crystal field.

PRECISION CUTTERS OF QUARTZ
for
COMMUNICATIONS & OPTICAL USES

The *JAMES KNIGHTS* Co.
SANDWICH, ILLINOIS

York, and in 1927 he became general engineer in the operating department of the United Gas Improvement Co., Philadelphia, two years later being transferred to the Connecticut utility as general engineer. He has been in charge of the engineering and construction for the recently installed 25,000 kw. steam generating unit at Montville and the 45,000 kw. unit at Devon station. Mr. Forman will report to C. T. Hughes, general operating superintendent.

•

A. H. Stubbers Elected Head of Ilsco Copper

Andrew H. Stubbers has been elected president of the Ilsco Copper Tube & Products Co., Mariemont, Ohio. Mr. Stubbers has been with the Ilsco or-

ganization for more than fifteen years, during which he has been active in practically all the departments of the plant, so that he has a firm grasp on information as to every factor from the raw material to the finished products. He will continue as sales manager.

•

► JOHN H. WIEAND has been appointed assistant manager of the systems division of the Philadelphia Electric Co. Mr. Wieand has been identified with the Philadelphia Electric Co. since 1918, and has been a member of the systems division since 1939.

► C. ELIOT LAWRENCE has been appointed superintendent of the Falmouth (Mass.) district of the Cape & Vineyard Electric Co., succeeding the late Kenneth P. Sheldon. His territory will include Falmouth, Bourne and Sandwich. Mr. Lawrence joined the company 19 years ago and became superintendent of the meter department in 1930, with headquarters at Hyannis, Mass. M. E. CHASE of Hyannis suc-

No. 4: Tips on Condenser Tube Maintenance

Simple methods of repairing and reworking worn tubes

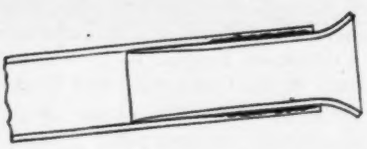
Most of the causes of condenser tube damage can be eliminated . . . and even where damage has occurred, many tubes can be repaired and put back into useful service, thereby conserving copper and other critical war materials.

The chief causes of trouble are: 1. Excessive local turbulence; 2. Finely divided air bubbles; 3. Excessive solids in the cooling water. Methods of preventing these have been discussed in previous messages in this series and further information will be supplied on request.

The following suggest several practical methods of overcoming certain types of damage to tubes, which can be easily applied under today's conditions.

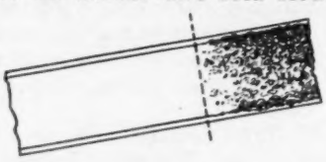
The use of sleeves for pitted inlet ends

When tubes begin to show signs of pitting on inlet ends, the usual practice is to set flared sleeves in the



tubes. These sleeves should be carefully made to fit tightly and leave no shoulder at the inside end which might cause turbulence.

Where the ferrules have been destroyed



In some cases, the tubes may have failed only at the inlet end, with very little corrosion elsewhere. However the ferrules may have been destroyed. In this situation, the bad ends may be cut off, the tubes then stretched and used again.

Changing the location of tubes

When tubes begin to leak because of pitting or plug-type dezincification, and replacement seems indicated, many tubes may still be in good enough condition for further use. All the tubes can be withdrawn and carefully tested. The poorest can be discarded and those passing the test can be re-used. Longer service will follow if these re-used tubes are placed in that part of the condenser where the least corrosion has occurred.

We will be glad to send you further information on methods of prolonging condenser tube life if you will mail your request on a letterhead to the address below. 4394

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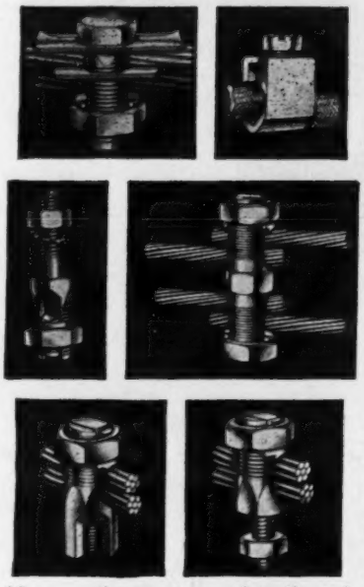

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ceeds him as head of the meter department.

▶ O. E. OHLUND, superintendent, overhead division of the construction department, Commonwealth Edison Co., has relinquished active duties. He will remain with the company in an advisory capacity until the end of this year, when he will retire after 40 years of service. R. L. BARD, formerly assistant superintendent, succeeds Mr. Ohlund as superintendent of the division. New assistant superintendent is M. L. BANK, former district supervisor, circuits.

▶ ROY W. JOHNSON, of Stamford, Conn., has been appointed deputy director of WPB's Facilities Bureau. He replaces Col. Gordon E. Textor, who returns to duty with the Corps of Engineers. Mr. Johnson joined WPB last December as assistant to Ralph J. Cordiner, then director general of war production scheduling. Mr. Johnson had been associated with Mr. Cordiner at Schick, Inc., Stamford. He was associated with General Electric Co. at Bridgeport, Conn., before joining Schick, Inc.

▶ JAMES W. WOLFE of Inman, S. C., has been elected chairman of the South Carolina Public Service Commission, effective July 1. When Mr. Wolfe assumed the chairmanship it was for the second time. He was chairman in 1936-37. He is a former president of the National Association of Railroad and Utilities Commissioners.

▶ DAVID L. BROWN has been appointed manager, Pontiac (Mich.) division, Consumers Power Co., to succeed the late B. G. Campbell. Mr. Brown has been superintendent of gas distribution at Pontiac division since March, 1917. Earlier he worked for the Michigan Light Co., a predecessor of Consumers, in Flint, and had assisted, as a construction foreman, in the building of an addition to the Pontiac gas plant. Previously he had spent three years as construction foreman on gas plants and distribution systems in Texas and two years as superintendent of production and distribution for the Corpus Christi Gas Co., Corpus Christi, Texas.

▶ W. TRIGG MILLER, a member of the staff of the Tennessee Railroad and Public Utilities Commission for the past six years, has been granted a leave of absence to become public utility specialist on the Washington technical staff of the War Production Board. The new WPB aid, a graduate of Princeton University, has been loaned at the request of the war agency. Mr. Miller served as technical adviser in 1940 for the National Association of Railroad and Utilities Commissioners in a check-up of the adequacy of railroad and public utility facilities throughout the United States in relation to the national defense program.

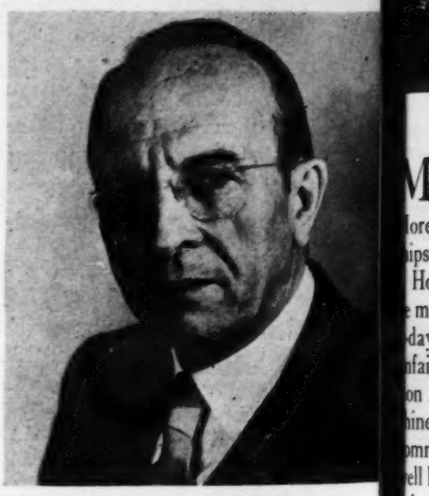
•

Westinghouse Elects Two Vice-Presidents

Election of the two district managers as vice-presidents of the Westinghouse Electric & Manufacturing Co. has been announced by A. W. Robertson, chairman of the company.

The new Westinghouse vice-presidents are Fred T. Whiting, manager of the company's northwestern district

F. T. Whiting



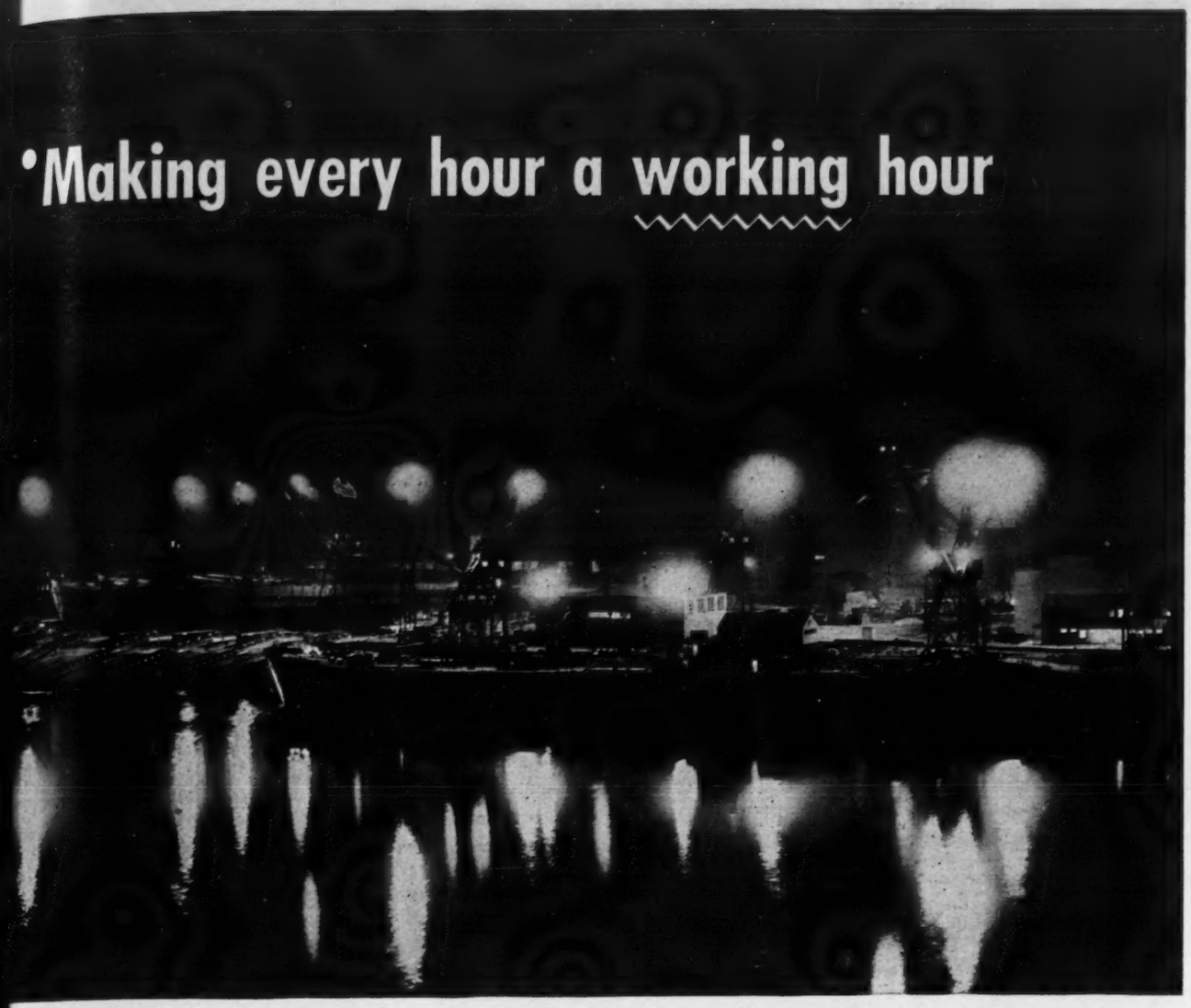
C. A. Dostal

with headquarters in Chicago; and Charles A. Dostal, Pacific Coast district manager, with headquarters in San Francisco. Duties and headquarters of both men are unchanged.

As northwestern district manager since 1930, Mr. Whiting has directed the company's sales activities in a territory which includes parts of ten states. He has been associated with Westinghouse since 1913.

Mr. Dostal has been Westinghouse Pacific Coast district manager since

"Making every hour a working hour



MORE destroyers and aircraft carriers! More sub-chasers! More landing barges! More cargo ships! More—more—more!

How is this enormous demand to be met? The best answer is 24-hour-a-day production. And that requires unfailing transmission and distribution . . . power for hard-working machines, for welding, for lighting, for communication. For victory may well hinge upon the ability of America's shipyards to produce boats in ever-increasing numbers at record-breaking speed.

Only the best Electrical Wires and Cables can be trusted with these responsibilities . . . Wires and Cables as trustworthy as modern manufacturing methods can make them.

That is why products of American Steel & Wire Company play such important roles in wartime ship construction. Our engineers are working constantly to improve quality. Tireless research goes on day after day. New ideas, new production methods are studied — tried. When peace comes, American Steel & Wire Company Electrical Wires and Cables will be ready to meet the even greater demands of the postwar world.

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JUST OUT

ELECTRONIC CONTROL OF RESISTANCE WELDING

By GEORGE M. CHUTE
Application Engineer
General Electric Company, at Detroit

389 pages, 6x9
173 illustrations, $4.00

—Exactly how the electron tubes and other elements of these controls work—

—What circuits are used and why—

—What happens at every point in the circuit, at each moment of operation—

—How to install the equipment—

—How to maintain it for long life and efficient service—

—that's the sort of information you can get from this new book—by means of some of the most practical, clear, and easy-to-understand explanations you ever have seen applied to a technical subject.

Covers

—ignitron contactor
—time-delay relay
—automatic weld timer
—pulsation welding
—sequence controls
—synchronous spot-weld timer
—weld heat control
—seam-welding control
—all-tube control for seam, spot and pulsation welding
—welder controls used with series capacitors
—capacitor stored-energy control
—reactor stored-energy control

Here is an unusually simple and practical manual, fully explaining the tubes and circuits used to control resistance welders in industrial plants, for the aid of men who work with and maintain these controls. From it, the man with no previous training in electronics can gain a sound knowledge of tubes and circuits and their application in all varieties of control devices, including synchronous timers and stored energy controls. How the tubes work, power requirements, the factors for good welding involved, installation and maintenance of the devices—everything is covered to give the reader the ability to get the most in long life and efficient service from these equipments.

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1939, directing the company's sales activities in all or parts of eleven western states and in Alaska and the Hawaiian Islands. He has been with the company for nearly 37 years.

▶ FRANK T. HITCHCOCK, JR., Boston Edison Co., has been elected chairman of the Lighting Engineers of New England. FRED S. MASON, Brockton Edison Co., has been made vice-chairman, and FRANK H. JONES, Lowell Electric Light Corp., secretary-treasurer of the organization.

▶ OSCAR M. FRYKMAN, who retired after 33 years of service in the electrical inspection department of the City of Minneapolis, during 31 of which he served as chief electrical inspector, was honored at a testimonial dinner sponsored by all branches of the electrical industry. On behalf of the industry, Mr. Frykman was presented with an illuminated scroll on which were recounted his services as a citizen, a public servant, and a member of the electrical industry.

▶ LESTER W. F. KASSING, who recently resigned as chairman of the War Manpower Commission's ten-county Fort Wayne, Ind., area employment stabilization committee, has been appointed industrial relations and safety director of the Indiana Service Corp., Fort Wayne. As safety head, he assumes the duties formerly held by RICHARD SAFFEN, now in the Army. The industrial relations position is newly created.

▶ ALEXANDER P. THOMS, assistant superintendent of construction and veteran of 41 years of service with Commonwealth Edison Co., has retired from active duty. Two farewell luncheons were held in his honor by his associates and he was presented with a testimonial booklet and a diploma "graduating him to a life of leisure." Mr. Thoms started his utility career in 1902 as a substation operator, later transferred to the load dispatcher's office, and in 1912 was appointed chief load dispatcher. He has since served as superintendent of underground cable work, superintendent of the street department and assistant superintendent of construction.

▶ F. D. EGAN, electrical superintendent, Bethlehem Steel Co., Lackawanna, N. Y., has been granted an indefinite leave of absence. A past-president of the Association of Iron and Steel Engineers, he has been superintendent since 1923. R. W. GRAHAM, formerly assistant superintendent, will succeed Mr. Egan. Mr. Graham, who was an instructor at Cornell University, for three years, has been with the Bethlehem company since 1916. T. O. ZITTEL, formerly student engineer, has been made assistant superintendent. He was

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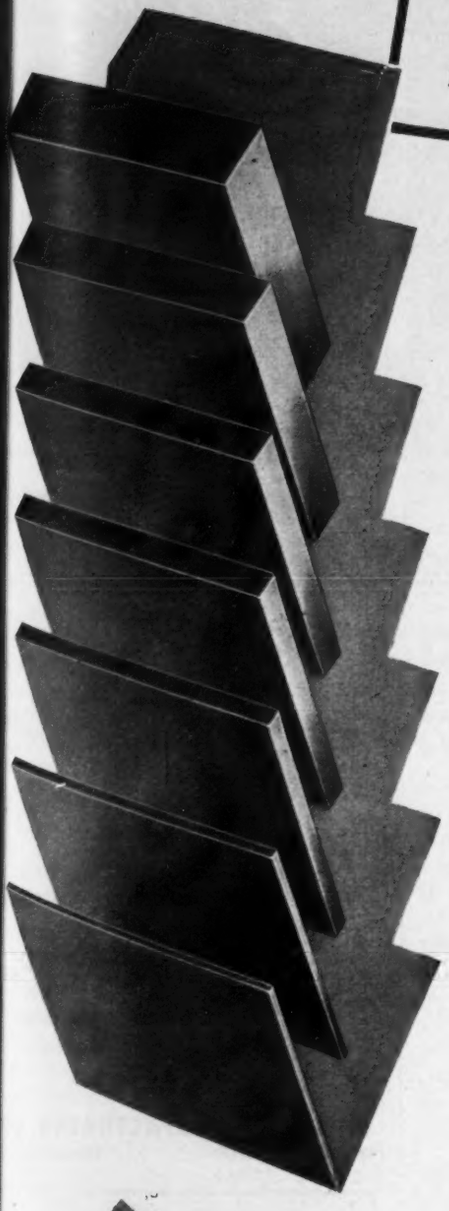
Compressive Strength	25,000-35,000 lbs. per sq. in.
Flexural Strength — Edgewise	16,000-20,000 lbs. per sq. in.
— Flatwise	16,000-20,000 lbs. per sq. in.
Impact Strength	0.6-0.8 ft. lbs. per in. of notch (Charpy or Izod)



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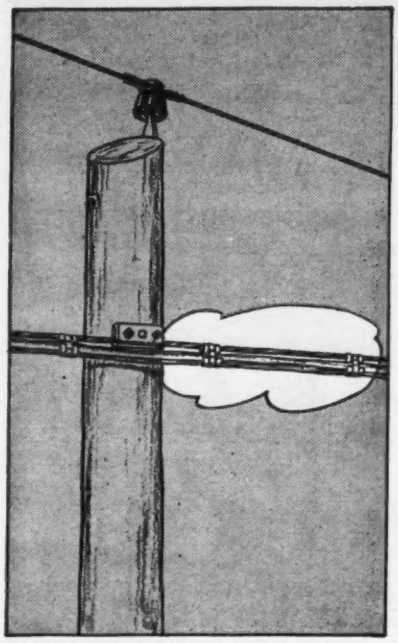
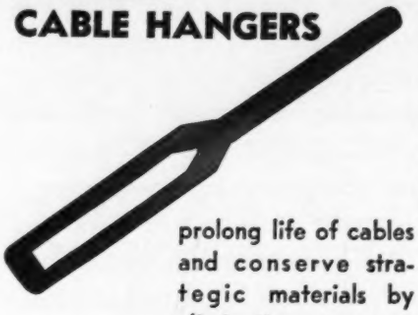
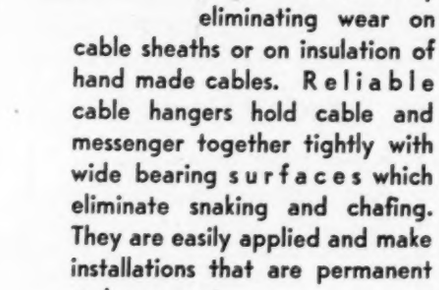
Reduce Maintenance



RELIABLE CABLE HANGERS



prolong life of cables and conserve strategic materials by eliminating wear on cable sheaths or on insulation of hand made cables. Reliable cable hangers hold cable and messenger together tightly with wide bearing surfaces which eliminate snaking and chafing. They are easily applied and make installations that are permanent and very neat.



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graduated from Rensselaer Polytechnic Institute in 1933 and was employed by the Bethlehem company in 1935.

OBITUARY

▶ KENNETH P. SHELDON, 36, superintendent of the Falmouth division, Cape & Vineyard Electric Co., died suddenly at Falmouth, Mass., on June 28.

▶ KENNETH B. PANCHOT, manager of the Tacoma division of the Puget Sound Power & Light Co., died on July 3, following a heart attack, while on a fishing trip in Rainier National Park. Mr. Panchot was 42 years of age.

▶ JOHN H. WHEELOCK, 70, president of the Sherman Co., electrical manufacturer, Fitzwilliam, N. H., and for some time active in the electrical signaling apparatus making field in New York City, died in that place June 25. He was a native of Paterson, N. J.

▶ GEORGE F. WEST, 80, identified in earlier years with the management and development of the Casco Bay Light & Power Co., Portland, Me.; Kennebec Light & Heat Co., Augusta, Me.; Kennebunk (Me.) Electric Light Co., before the last two underwent acquisition by larger utilities, died at Portland on July 12. He was a native of Somerville, Mass., and in recent years was engaged in water utility activities managed by the house of George F. West & Son, Portland.

▶ SIR ALEXANDER MACKENZIE, international financier and former executive of several power companies in South America, died on July 12 at his summer home at Kincardine, Ont., at the age of 80. He had been ill for several months. He was knighted in 1919. Sir Alexander resigned as president of the Brazilian Traction, Light & Power Co., Ltd., in 1928, after occupying that office for many years. He also held executive positions with the Sao Paulo Tramway, Light & Power Co. and the Rio de Janeiro Tramway, Light & Power Co.

▶ EDWARD F. SISE, a former president of the Northern Electric Co. and son of Charles F. Sise, Sr., founder of the Bell Telephone Co. of Canada, died at his home in Montreal on July 3, after an illness of several months. He was 66 years old. Mr. Sise was a partner in the insurance firm of Adams & Sise at the time of his death. He was born in Boston and in 1896 joined the Western Electric Co. in New York. Three years later he became secretary and general manager of the newly formed Wire & Cable Co. in Montreal. When the company was reorganized on a dominion basis in 1911 as the Imperial Wire & Cable Co. he was made managing direc-

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In 1913 Imperial Wire & Cable Co. amalgamated with the Northern ectric & Manufacturing Co. to form present Northern Electric Co. and . Sise became its first president. It s in 1919 that he resigned as presi- nt of Northern Electric, to be suc- eded by his younger brother, Paul Sise, and joined with R. P. Adams Montreal to form the insurance firm Adams & Sise.

CHARLES W. UNDERWOOD, who was sociated with the Westinghouse Elec- c & Manufacturing Co. for 32 years til his retirement in 1933, died on ne 30 in Buffalo, after an illness of o months. Mr. Underwood served as strict manager in Buffalo and then as ecial representative. He first was entified with the sales department ere.

ISAAC L. OPPENHEIMER, retired execu- e and manager of utilities in Indiana, ntucky and Ohio that were in the sull system, died on July 7, after a art attack. He was 76 years of age. uring his association with the Ohio operties Mr. Oppenheimer served as esident of the Ohio Electric Light sociation.

JOSEPH A. ROY, 58, electrical engi- er of the Cambridge (Mass.) Electric ight Co., died recently at Newton, lass. He was educated at Harvard Uni- rsity and the Massachusetts Institute Technology and taught electrical urses at Franklin Union, Wentworth stitute and elsewhere for various pe- ods in addition to his regular work. e began work for the Cambridge com- ny in 1924, and rose from the position chief electrical operator to the sup- intendency of substations prior to his te responsibilities. He was active in e New England System Operators lub.

CARL E. HEISE, who retired in 1941 ter 43 years with Westinghouse Elec- ic & Manufacturing Co., San Fran- sco, died June 30 in the city of his rth. Born August 10, 1876, he was aduated from University of California 1898 with the degree of B.S. in elec- ical engineering, went to work for estinghouse installing motors and ooting trouble, took the test course East Pittsburgh and returned to San ancisco. In 1912 he entered sales ork and was made San Francisco dis- ict manager. In 1940 he was placed on ecial assignments and in 1941 retired. r. Heise was one of the organizers the San Francisco Electrical Develop- ent League and a past-president, ember of the Pacific Coast Electrical sociation executive committee and a ember of the executive committee of e southwestern section, I.A.E.I., at e time of his death.

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MANUFACTURING-MARKETS

G.E. Net Sales Rise 52 Percent in '43

General Electric Co.'s profit available for dividends for the first half of this year amounted to $21,061,629, or 73 cents a share of common stock, compared with $20,681,433 or 72 cents a share for the same period last year, President Gerard Swope has announced. These amounts were after provision for federal taxes on income and for post-war adjustments and contingencies, amounting to $136,000,000 in the 1943 period and $94,000,000 in the 1942 period, an increases of 45 percent.

Total earnings of employees for the first six months of 1943 amounted to $227,000,000 compared with $165,000,000 for the same period a year earlier, an increase of 38 percent.

Net sales billed (representing shipments) during the first half of this year amounted to $626,871,716 compared with $412,383,825 for the first six months of last year, an increase of 52 percent.

•

Adopts Group Insurance

Barkelew Electric Manufacturing Co., Middletown, Ohio, has adopted a group insurance program which includes life insurance, sickness and accident coverage, and surgical operation benefits. The group plan is being underwritten by the Metropolitan Life Insurance Co. on a co-operative basis whereby the employees contribute fixed amounts and the employer bears the balance of the entire net cost. C. W. Denny, Sr., is president of the company.

•

Acquires New Subsidiary

Borg-Warner Corp. of Chicago has acquired a new subsidiary through cash purchases of all of the stock of McCullough Engineering Corp. of Milwaukee, C. S. Davis, president of Borg-Warner, has announced.

The McCullough company will continue to operate as a self-contained unit under its present management and personnel and at its present site, with Robert McCullough, founder, remaining as president and director in active charge of the plant's operations.

•

Ask WPB Drive to Scrap Old Motors

Dealers in used electrical equipment have asked WPB to promote a campaign for scrapping of unrepairable electric motors.

The dealers also asked WPB to prepare a standard form on which they can interchange easily information contained on general stock lists. It was also recommended that an order be issued restricting the number of allowable lead wires to the minimum number required for normal operation of the type of motor at hand.

The suggestions were made at a meeting of the Used Electrical Equipment Dealers Industry Advisory Committee. WPB officials told the committee that rebuilding of used equipment is considered the same as repairing. Applications for rebuilding material submitted on form CMP-4B will receive the same consideration as applications for repair materials. Dealers will not be required to obtain ratings from customers for a used motor or for repair work.

•

U. S. Steel Supply Buys Moise Steel Co.

United States Steel Supply Co., a United States Steel Corp. subsidiary, has purchased the physical assets of Moise Steele Co. of Milwaukee, Wis., E. E. Aldous, president, has announced. The Supply Company will continue the steel warehouse business conducted formerly by Moise Steel Co. in Milwaukee.

Carl Gallauer, formerly vice-president of Moise Steel Co., has been appointed district manager and J. R. Beers, formerly manager of the Milwaukee sales office, United States Steel Supply Co., has been appointed assistant district manager.

Some Wartime Inventory Problems*

By C. HOWARD KNAPP
Assistant Treasurer Holtzer-Cabot Electric Co., Boston, Mass.

Inventory problems affect practically every activity of a business. Pricing routine is affected, regardless of OPA ceilings, because often a substitution in quality of materials will call for a higher or lower price. In addition, material procurement costs are greatly increased because of the need of engaging expeditors, or others, to search markets, and shipment costs may run higher because of express or air transport, or war risk insurance.

CMP Problems

The Controlled Materials Plan accomplishes much good, but it has developed into a wartime inventory problem. It has emphasized the need of having an accurate and complete knowledge of costs, for both prime and subcontractors. CMP is a delicate mechanism, and the balancing of a company's entire production schedule may be thrown off if a sub-contractor does not receive his material. The finest breakdown of material practicable is desirable for maximum CMP flexibility. A perpetual inventory is virtually a necessity, emphasizing again the desirability of maintaining an adequate cost system, since regulations bearing upon wartime manufacturing controls can be taken pretty much in stride by manufacturers who have kept abreast of the times in their industrial accounting procedures. This accounting should mirror almost from day to day the actual consumption of allocated materials, with reasons for variations from estimates.

The extent of the prime contractor's responsibility for material conditions in plants of sub-contractors is not entirely clear under CMP, but some checking of the latter's figures seems important. Trying to extend the accounting system beyond the gates of the prime contractor's plant is enormously burdensome, but some organizations are undertaking it.

The business problems of the automobile, radio and refrigerator industries are ended for the duration because their basic materials and productive equipment are needed for vital war purposes. Their real problem is of the post-war period, when they return to normal production and must meet competition from some of the tremendous war plants such as Kaiser, Boeing and others, who will undoubtedly compete. The consumption goods indus-

* From a paper before the National Association of Cost Accountants at Boston.

es will have many inventory prob-
ms because of material, manpower
d transportation shortages, but will
ntinue to function as long as they
not retard war material production.

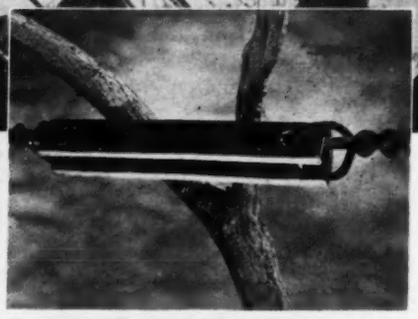
Basic Materials

It is not possible to speculate in
sic materials, but even if it were, the
velopment of substitutes (plastics,
nthetic rubber, new steels, etc.) has
en so marked during the war that
ch a gamble would be rather hazard-
s. However, at the end of this war it
pears probable that industry will be
lled upon to produce at a high vol-
ne to meet post-war demands even
w being built up. Overseas markets
e likely to develop. There is reason
believe that prices of raw materials
ll probably rise and that an accumu-
tion of inventories of materials not
kely to face substitution is a good
dge against continuance of inflation.
one case a company plans to cast
t all its inventories on the first-in,
rst-out basis on the assumption of a
wnward price trend, especially of
bricated items. This appears sound,
cause in the event of government re-
nds for amounts expended on con-
cts, the most recently acquired pur-
ases are likely to be allocated to the
nceled contracts.

Control of materials in sub-contract-
s' plants has become of great impor-
nce. In a representative case a
mpany sends raw material through
x or more hands and the stock as-
mbly for one product goes through
ne steps before completion. To con-
ol this, each sub-contractor is fur-
shed at the end of each month with
transcript of all materials delivered
and shipped by him. The sub-con-
ctor is required to furnish the prime
ntractor by the 25th of each month
ith a report of the scrap made by
m, which is incorporated in the tran-
ript. This company has two auditors
ntacting the sub-contractors, check-
g inventories and differences between
cords, with good results.

Reserve for Contingencies

A substantial reserve for contingen-
es should be made out of each year's
rnings. Such accounting means
naller surpluses and dividends kept
low as possible. Trust funds for
me widows and small children should
t be made in substantial amount in
dustrial enterprises subject to risks
casioned by war inventory hazards.
rge dividend payments add to the in-
tion problem. A greater control over
ending exists where corporate funds
e kept in the company treasury or in-
sted in government securities than
here paid out in dividends. A sub-
ntial reserve for contingencies helps
djustment to the post-war era.



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Field Reports on Business

Heavy electrical manufacturers report orders in good volume from domestic and foreign sources identified with the war effort. Considerable electrical business is involved in war work in shipyards and naval bases. Utility orders for the most part are confined to maintenance and repair materials.

CHICAGO

A slight increase in electrical contracting activity is seen for the Chicago area in coming months. Some 3,000 housing units are to be built in the next three months. Wiring contracts are expected to average $60-75 per unit. Wiring will be knob and tube with rubber-covered wire used for "hot" wires, weatherproof wire for the neutrals.

The shift of priority control authority from Washington to regional WPB offices is seen as speeding issuance of priorities for maintenance and repair of existing installations under the Controlled Materials Plan. Effect of efforts to distribute subcontracts among small business firms in the area is being reflected in increased business among small electrical contractors in Chicago.

Near completion of the larger war-industry plants is reflected in a decrease of around 5 percent in demand for motors in sizes 50 hp. and over, according to used equipment dealers. Demand for small motors, up to 50 hp., continues strong, with prices ranging around 85 percent of list. Electrical manufacturers are reported six to eight months behind on orders for new fractional-horsepower sizes.

Among Chicago's 30-odd exclusively electrical wholesalers business is reported spotty, with some houses enjoying better business than last year, particularly those actively promoting maintenance and repair business in war plants and essential civilian industries. Generally, however, business volume has been consistently off for the first six months of this year.

Heavy electrical manufacturers report orders in good volume from domestic and foreign sources identified with the war effort. Utility orders are weak and in the main confined to maintenance and repair materials.

NEW ENGLAND

The movement of electrical equipment and supplies toward shipyards and naval bases in this area continues at a good pace. Ventilating units and electric blowers are receiving attention; small bench tools for supply ships and tenders are being bought from Connecticut manufacturers in good volumes; more than $50,000 total in friction tape was among recent naval schedules and heavy orders for storage batteries are keeping manufacturers busy.

It is expected that the Navy Department will build about one-half mile of overhead line to supply emergency service to Homestead Utilities Co., Prudence Island, R. I. In the greater Boston area additions and changes to factory power services continue with slight moderation, according to records of motor installations during the past fortnight. Radio supplies in lots averaging $1,000 are being bid by specialists in communication fields here, including magnet wire, tubes, antenna wire and transmitting units. One contract completed this month called for 150 complete field service units and was handled by a Massachusetts manufacturer.

A contract for a two-story addition to the Weymouth Hospital has been awarded to M. S. Kelliher Co., Boston, at a cost of $178,250, and a number of contracts for temporary buildings involving the barest requirements in electrical wiring for light and power include units for Maine, New Hampshire and Connecticut estimated to cost less than $50,000. A contract for the construction of a fueling system to cost about $50,000 located in Connecticut has been awarded to C. Bianchi Co., Framingham, Mass.

NEW YORK

A number of heavy industries showed declines last week. Steel and electric power production were lower, while coal production and carloadings were higher for the week.

Three-fifths of all small manufacturing plants are producing at least some war goods and 40 percent of their combined output may be classed as war production, according to the Department of Commerce. The estimate was based upon a survey in late February and early March of approximately 62,000 firms.

Living costs of wage earners and lower-salaried clerical workers in the United States continued their upward movement, but at a reduced rate, in June with a rise of 0.1 percent, according to the National Industrial Conference Board.

Sales of New York and Brooklyn department stores showed an increase of 10 percent last week over the comparative week last year, according to the report issued by the Federal Reserve Bank of New York. For the preceding week the bank had reported a decline of 13 percent from the comparable week of last year, when the period contained one additional shopping day.

PACIFIC COAST

Marine electrical business is becoming an ever-increasing portion of the total volume of the business of manufacturers and also wholesalers, who are now using regular staffs for the purpose. The number of boats under construction makes even a storage battery installation of about $300 a sizable item when ordered for a fleet of 50 vessels. Another 100 corvettes are being planned for California shipyards.

Recent orders cover $20,000 of fuses and other protective equipment for Bonneville system; many installations of floods and boundary lights for air fields, such as in Riverside County, Calif., and Maricopa County, Ariz.; a quantity of 200 kva. transformers for City of Los Angeles; a considerable installation of d.c. generators for Treasure Island navy base: a 750-kw motor-generator set with switchgear equipment, totaling $50,000, for a naval air base and $35,000 welding sets for a Richmond shipyard.

Several new government installations and expansions are reported such as considerably increased ship facilities, involving motors and other power apparatus.

Bremerton, Wash., is building $1,000,000 worth of schools and Los Angeles is purchasing a sizable number of electrical fixtures for several schools.

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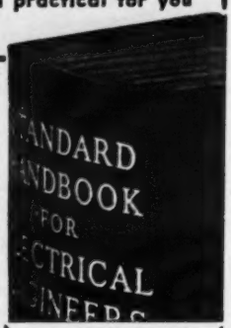

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Recent Rate Rulings

KANSAS CORPORATION COMMISSION has announced that reduction in penalty charges by some 50 Kansas electric and gas companies will result in a saving of $20,000 a year to patrons. Most of the penalty charges were on a 10 percent basis and have been reduced to an average of less than 5 percent. The penalty charges were enforced against delinquent patrons. The order does not affect charges of the Kansas Power & Light Co., it was explained, because its charges were below the 5 percent set by the commission. In some instances, the commission stated, the charges were as high as 20 percent. The public utility companies urged that the penalty charges were necessary to cover collection costs.

OKLAHOMA GAS & ELECTRIC CO. has been authorized by the Arkansas Department of Public Utilities to reduce its rates $27,147 to power and light customers in northwest Arkansas. The revised rates were approved on application of the utility. A. B. Hill, chairman of the commission, said the reductions were not contrary to the March 26 order of the department which established the policy of providing for refunds of excess earnings to customers during the war rather than reductions in rates. "The expression of this policy (March 26 order) was in general terms and not a fixed determination as to action that would be followed in regard to any particular utility company operating under the jurisdiction of the department," the commission stated. . . . O. G. & E. has chosen to put into effect certain rate reductions rather than enter into a refund agreement. The effect of such choice by the O. G. & E. is substantially the same as would be obtained had a refund agreement been consummated."

ARKANSAS UTILITIES COMMISSION has assumed jurisdiction in rate cases involving eleven major Arkansas corporations and has arranged conferences for July 26-31 to lay the groundwork for possible refunds to consumers at the end of the year.

INDIANAPOLIS POWER & LIGHT CO.'s reduced rates to twelve down-town business commercial users have been approved by the Indiana Public Service Commission. The petition sought a modification of the company's schedule to allow consumers with an underground supply the same rate as that now charged for overhead supply. Seventy-four other down-town commercial users also can benefit under the modification when they can change their equipment from direct to alternating current. When this is done, the saving will amount to approximately $107,000 annually.

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Sylvania Electric Buys Electro Metals, Inc.

Sylvania Electric Products Inc. announces the purchase of the manufacturing facilities, including plant and machinery, formerly operated by Electro Metals, Inc., Cleveland, Ohio, manufacturer of lead-in wires for use in radio tubes, incandescent and fluorescent lamps.

The present staff of employees will be retained and Sylvania will continue operations at the present site.

MATTHEWS SERIESWITCH

It Is a Fallacy to Take Chances

that some little boy or girl will not pick up or attempt to play with a live wire on the ground caused by an open circuit on a series circuit street lighting loop. Just because such an accident has not yet happened on any of your circuits, there can be no guarantee that it may not happen tonight, if your circuits are not adequately protected.

The reason for the development of Matthews Serieswitch is because a child was killed and a man injured within a few weeks of each other and some of those who had series street lighting circuits wanted an efficient and inexpensive device which would instantly cut out an open circuit, without affecting any of the rest of the main circuit or other loops off the main circuit.

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Sales Opportunities

OREGON—Columbia Metals Corp., Portland, recently organized, has contracted with Chemical Construction Corp., 30 Rockefeller Plaza, New York, N. Y., for design, construction and operation of new plant on site to be selected for production of alumina from clay. Plant will comprise several large one and multi-story processing and production buildings, with auxiliary structures for storage, distribution and other miscellaneous service. All machinery will be electrically operated, with power supply secured from Bonneville high-tension system of government. A large power substation will be located at plant site and transmission lines extended to that point. Several transformer stations will be constructed in different parts of plant. Project will include development of extensive clay deposits in Clackamas County, Ore., and Cowlitz County, Wash., for raw material supply, with machinery and electrical equipment for large output. Entire program will cost about $4,000,000, with financing by Defense Plant Corp., and RFC. Proposed to begin work at early date. Contracting company noted is a subsidiary of American Cyanamid Co., same address.

INDIANA—Light and Water Department, Kendallville, is completing plans and proposes early call for bids for extensions and improvements in municipal power plant, primarily for expansion in steam division. New boiler, stoker and auxiliary equipment will be installed. Cost reported close to $100,000. R. W. Noland, Medical Arts Building, Fort Wayne, is consulting engineer.

OHIO—War Department, Washington, D. C., has approved plans for new army air force installation, comprising hangars, shops, warehouses and other buildings, with mechanical and electrical equipment. Also, electrical distribution lines, with service connections and other operating facilities. Entire project will cost over $3,000,000, and will be supervised by U. S. District Engineer Office, Dayton. Work is scheduled to be carried out at once.

VIRGINIA—Navy Department, Washington, D. C., has authorized plans for improvements in waterfront in vicinity of a naval operating base, including power substation and electrical distribution lines, signal tower, telephone building, electric-operated pumping station for water supply and other structures and facilities. Entire project will cost about $7,500,000. Also will make extensions in a naval air station in same district, including hangar and lean-to structures, assembling shop and other buildings, with mechanical and electrical equipment. Complete program will cost about $1,900,000. Work will be carried out under direction of Bureau of Yards and Docks, Navy Department, Washington, and will proceed at early date.

OREGON—U. S. District Engineer Office, Pittock Block, Portland, has approved plans for new airport, including hangar, shops and other structures, with mechanical and electrical equipment and facilities. Also, electrical distribution lines, control station, lighting system, etc. Entire project will cost approximately $200,000.

OHIO—Sinclair Refining Co., 1435 Miami St., Toledo, plans large electric-operated pumping plant in connection with new bulk oil terminal on Maumee River. Project will include warehouses, docks and other structures, with mechanical and electrical equipment, and is estimated to cost about $1,000,000. Company also will build series of electric-operated pumping stations for booster service at different points along route of new pipe line for oil and gasoline transmission from oil refining plant in Indiana to new bulk terminal over 200 mi. Project will cost about $4,500,000. Entire development has been authorized by WPB and work is scheduled to begin at once. Main offices at 630 Fifth Ave., New York.

IOWA—Civil Aeronautics Authority, Washington, D. C., and regional office, City Hall, Kansas City, Mo., will soon take bids for extensions and improvements in airport, comprising new buildings with electrical facilities, lighting system, control station, etc. Cost estimated about $650,000.

ALABAMA—Bechtel - McCone - Parsons Corp., 605 West Fifth St., Los Angeles, Calif., engineer, has contracted with government for expansion in aircraft modification center, constructed and operated for government, including hangars, shops, warehouses and other industrial structures with mechanical and electrical equipment. Entire project will cost about $1,750,000 and will be financed by Defense Plant Corp. Work will be carried out at early date.

IOWA—Construction Service, Veterans Administration, Washington, D. C., receives bids until Sept. 14 for construction of additional buildings, with electrical and other utilities at institution at Knoxville.

ALABAMA—U. S. District Engineer Office, Mobile, has approved plans for new hangar at an air base, estimated to cost over $400,000, with electrical and mechanical equipment. Work is scheduled to be placed under way at early date.

CALIFORNIA—Federal Public Housing Authority, 785 Market St., San Francisco, has been authorized by Federal Public Housing Agency, Washington, D. C., to arrange plans for 2000 dwelling units estimated to cost about $5,000,000. Project will include electrical distribution system with service connections, fixtures, etc. Proposed to ask bids at early date.

OHIO—Goodyear Aircraft Corp., Akron, a subsidiary of Goodyear Tire & Rubber Co., same address, has contracted with government for expansion in a plant, comprising new buildings with mechanical and electric equipment and facilities for large increased output. Cost estimated about $2,500,000. Also, for similar expansion in a branch plant at Arizona, to cost approximately $2,450,000. Both projects will be financed by Defense Plant Corp. Work will be carried out soon.

WISCONSIN—City Council, La Crosse, and Civil Aeronautics Administration, Washington, D. C., and 608 South Dearborn St., Chicago, Ill., plan new airport, comprising hangar, shop and other structures, with mechanical and electrical equipment. Also lighting system, with control station and other operating facilities. Cost about $550,000, of which $400,000 has been allotted by government and remainder to be provided by municipal bond issue. Surveys are in progress and work on construction is scheduled to begin soon. J. H. Barth is city engineer.

Manufacturers Make Sales Assignments

Electrical manufacturing companies have recently announced several new sales appointments.

William A. Moss, A. B. Chance Co. representative, who was recently transferred from Atlanta, Ga., to Kansas City, has completed his mission in Kansas City and has returned to Atlanta, where he will resume his contacts in the southwestern states. E. G. Ryman, assistant sales manager for the company, will continue the company's work in Kansas City as part of his new assignment to contact prime contractors and utility customers in Kansas City, St. Louis, Wichita, and Tulsa.

Porcelain Products, Inc. has appointed Harvey M. Olmstead of Denver, Colo., as representative for Colorado, New Mexico and Wyoming. Mr. Olmstead takes the place of the late J. Q. Lalor.

Engineering, sales and servicing of Esterline-Angus instruments for the Chicago area have been taken over recently by Murphy & Dickey with offices at 537 S. Dearborn Street, Chicago.

Electrical Engineers Equipment Co. has appointed Harold C. Fiske, Minneapolis, district representative in most of North and South Dakota, Minnesota and some western counties of Wisconsin.

Cochrane Corp., Philadelphia, has appointed the Metrol Co. as flow meter representative for the Detroit territory, with headquarters at 2970 West Grand Boulevard, Detroit. It will also handle Hays combustion control and instruments, Reliance gauge columns and Wilson tube cleaners. Cochrane also has announced the appointment of Bushnell Controls & Equipment Co. for the direct sale of Cochrane flow meters in California, western Nevada and Arizona. C. C. Moore & Co. Engineers, Inc., Pacific Coast representatives for Cochrane Corp., continue to handle all Cochrane products including flow meters in Oregon, Washington, British Columbia, Alaska and all Cochrane products excepting flow meters in California, Nevada and Arizona.

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267,008 Ice Boxes Authorized by WPB

WPB has authorized the construction of 267,008 non-mechanical refrigerators for civilian consumption during the third quarter, but its Consumer Durable Goods Division anticipates that materials shortages and manufacturing difficulties will hold actual production below this figure.

The quota is 27,433 units above that for the second quarter. Under the quota no more than 50 sq. ft. of hardboard (Masonite) may be used per unit. The program establishes minimum performance standards.

The new quota has been assigned to 36 manufacturers, 28 of whom participated in last quarter's quota. Four manufacturers who had quotas last quarter did not apply for quotas this quarter.

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Workers' Ideas Needed to Help Win War

American war industry must get production-increasing ideas from the men and women down in the shop in order to send the armed forces sufficient equipment for final victory. This warning was given war plant managers recently by Charles R. Riker, suggestion system co-ordinator for the Westinghouse Electric & Manufacturing Co., at a meeting of the National Association of Suggestion Systems held in New York.

The job of doubling production with the existing means is primarily one for trained and experienced production engineers and supervisory staffs working full-time and overtime, Mr. Riker said. The ordinary workman through the suggestion system can be of very great help in solving this tremendous problem of producing the equipment that is absolutely necessary to win the war, he added.

•

Ilg Makes Plans for New Research Laboratory

Plans for a new research laboratory, remote from the present plant of the Ilg Electric Ventilating Co., 2850 North Crawford Avenue, Chicago, have been approved by the board of directors.

The new building is to be constructed immediately west of the present plant. Of one-story, modern construction, it is being specifically built to be shake-proof and to a considerable extent soundproof.

The company has outgrown the present research facilities, which were an integral part of the plant and were subject to production noise and vibration, John M. Frank, president, stated. Equipment for the new building will include latest scientific instruments for measuring air, electricity, sound, light and vibration.

•

G.E. Stockholders at Peak

General Electric Co. on June 25 had 225,595 stockholders, a new high record and an increase of 5,393 over a year ago, according to W. W. Trench, secretary.

•

Changes Corporate Name

York Ice Machinery Corp. has merged with a subsidiary, the York Corp., and henceforth will be known by the latter name, S. E. Lauer, president, has announced.

CALL YOUR DISTRIBUTOR

Mill Supply Distributors are specialists in keeping our war plants supplied with the necessary tools and equipment to help them in turning their wheels for All-Out Production.

They will always be ready to show you the advantages of Coffing Hoisting equipment.

Illustrated is Model AG "Safety-Pull" Ratchet Lever Hoist.

Write today for catalog EG-6

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Ratchet Lever, Spur Geared, Electric and Differential Hoists
Trolleys
Utility Maintenance Tools
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VITAL TO THE WAR EFFORT

RENEWABLE FUSES and KLIPLOK CLAMPS

Shutdowns caused by unnecessary fuse blowings "sabotage" the war effort. For DOUBLE PROTECTION and THREE TIMES THE SERVICE install this famous TRICO Combination.

TRICO FUSES are different. The powder-packed renewal element is custom-built to give the utmost in safety and service.

KLIPLOK CLAMPS are as important as good fuses. They lock fuses and clips together, supplying that needed pressure that eliminates burnt fuses and clips, unnecessary fuse blowings and wasted current. There's a size for every clip.

WRITE FOR BULLETINS 1 & 6

TRICO FUSE MFG. CO., Milwaukee, Wis.
In Canada: IRVING SMITH LIMITED, Montreal

BOOKS RECEIVED

Radio Trouble-shooters Handbook. By A. A. Ghirardi. Published by Radio & Technical Publishing Co., 45 Astor Place, New York. 744 pages, illustrated. Price $5.

While framed to be a reference book for the radio service man, it cannot fail to be of great practical (not theoretical) value to the industrial or utility electrical engineer engaging in electronic applications. The final fourth, particularly, has industry practice data hardly approximated elsewhere; *e.g.*, grid-bias values for tubes; color and designation codes for resistors, tubes and capacitors; tube characteristics and base diagrams; nomograms (Sylvania) for R.L.C. and time constants; volume control schematics; wire tables, coil and filter design data; decibel and wave-length tables. Thus, wholly apart from the three-fourths devoted to the case troubles with 4,800 models of 200 makes of sets and similar practice information (which incidentally would have meaning for a utility's appliance service bureau), there is a unique fund of practical data of the hard-to-find kind for whoever works with whatever electronic circuits.

Pre-Service Course in Electricity. By William C. Shea. John Wiley & Sons, Inc., New York. 276 pages, illustrated. Price $2.

About as simple as electrical fundamentals can be made, this book is for inductees whether or not they are assigned to electrical training courses. The outline was framed in official circles as PIT (pre-induction training) No. 101, the author drew his material from technical and field manuals of the War Department. Pictures are largely military, but problems are from the work-a-day world.

Basic Electricity for Communications. By W. H. Timble. John Wiley & Sons, Inc., New York, N. Y. 603 pages, illustrated. Price $3.50.

All the familiar Ohm's law, Kirchhoff law, loop test, etc., are extended and warped in the direction of electronics and communication without detracting from the fundamental unity for power treatment as well. There are many problems and a high percentage are from the electronic field. Of particular value to the power engineer groping for an entrance to electronics is the chapter on circuits and Thevenin's theorem. It is a good steppingstone to filters, grid control, coupling, etc., before taking up the elements of vacuum tubes which follow.

Engineering Index. (58th Edition.) Published by Engineering Index, Inc., 29 West 39th Street, New York. Price $50.

Over 25,000 articles in 1942 technical literature annotated, cross-referenced and indexed along with lists of authors and reviewed publications.

Electronic Control of Resistance Welding. By George M. Chute. McGraw-Hill Book Co., New York. 389 pages, illustrated. Price $4.

Practical and pertinent is this instruction book by a General Electric author intended to be helpfully detailed about installation, operation and adjustment. In the process it explains the ignitron contactor, proper tube loading, delay relay, thyratron, automatic timers, voltage requirements, synchronization, quality control. Part III is devoted to energy-storage welding in its several commercial forms.

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(Classified Advertising)

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EMPLOYMENT SERVICE

SALARIED POSITIONS — This advertising service of 33 years' recognized standing negotiates for high salaried supervisory technical and executive positions. Procedure will be individualized to your personal requirements and will not conflict with Manpower Commission. Retaining fee protected by refund provision. Identity covered and present position protected. Send for details. R. W. BIXBY, Inc., 262 Delward Bldg., Buffalo, N. Y.

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POSITION DESIRED—Graduate electrical engineer, married, age 38, draft exempt, twelve years present connection. Broad experience, electric, water, gas and ice-rates, power sales, operation and public relations. Excellent reference. Release obtainable. Desires position as Engineer, General Superintendent, or Manager of public utility. PW-571, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

ELECTRICAL ENGINEER, 37, married, desires permanent supervisory or executive position. Experience includes various semi-supervisory positions in production, General Electric test course, and ten years in public utility. Has special training in power application and lighting layout. Especially experienced in customer contact and sales. PW-572, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

SELLING OPPORTUNITIES

OFFERED—WANTED

Selling Agencies—Sales Executives
Salesmen—Additional Lines

OPPORTUNITY WANTED

ELECTRICAL SALES ENGINEER desires additional distribution and transmission lines. Middle West. RA-564, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

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To take charge of generation and distribution. Experience operating hydro-electric power plant, preferred but not essential. Studious, sober, able to handle men, draft exempt. Position permanent. Open September first. Salary $350.00 monthly. Location Northwest, population 5,000. Include snapshot and give three references covering ability and character.

P575 Electrical World
68 Post Street, San Francisco, 4, Calif.

WANTED ELECTRICAL ENGINEER

with Transformer design experience; Pittsburgh district; our staff knows of this opening; rapidly growing manufacturer.

P-574, Electrical World
330 W. 42nd St., New York City 18, N. Y.

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PW-566, Electrical World
330 West 42 St., New York 18, N. Y.

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in operating condition or burnt out. Mail us list giving complete nameplate data and stating condition.

We Rewind, Repair and Redesign all Makes and Sizes
ALL TRANSFORMERS GUARANTEED FOR ONE YEAR
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STATION M Since 1912 CINCINNATI, OHIO

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750 KW, 250 volts, Allis-Chalmers, synchronous
75 KW, 125 volts, Crocker-Wheeler, synchronous
35 KW, 125 volts, Electric Machinery, squirrel cage

MOTORS—3 PHASE 60 CYCLE

400 HP, 514 RPM, 440 volt, Westg, slip ring.
335 HP, 600 RPM, 2300 volt, GE, syn.
300 HP, 720 RPM, 2200 volt, G.E., Sl. Rg.
260 HP, 514 RPM, 4000 volt, G.E., syn.
250 HP, 600 RPM, 4000 volt, G.E., sync.
250 HP, 600 RPM, 2200 volts, GE, slip ring
200 HP, 900 RPM, 440 volt, Westg., sl. rg.
200 HP, 600 RPM, 2200 volt, G.E., sl. rg.
200 HP, 450 RPM, 2200/4000 v., G.E., sl. rg.
150 HP, 1800 RPM, 2300 volt, Al. Ch. sq. cg.
150 HP, 900 RPM, 440 volt, Al. Ch. sl. rg.
150 HP, 720 RPM, 440 volt, G.E., slip ring.
150 HP, 600 RPM, 440 volt, G.E., slip ring.
150 HP, 400 RPM, 440 volt, G.E., sq. cg.
125 HP, 720 RPM, 440 volt, G.E., slip ring.
100 HP, 900 RPM, 440 Westinghouse, sq. cg.
100 HP, 900 RPM, 440 volt, G.E., slip ring.
100 HP, 720 RPM, 440 volt, G.E., slip ring.
100 HP, 720 RPM, 440 volt, G.E., sq. cg.
100 HP, 600 RPM, 440 volt, G.E., slip ring.
100 HP, 600 RPM, 440 volt, G.E., sq. cg.
100 HP, 514 RPM, 440 volt, G.E., sq. cg.
100 HP, 450 RPM, 440 volt, G.E., sq. cg.
90 HP, 400 RPM, 550 volt, Cr. Whlr, sq. cg.
75 HP, 900 RPM, 4000 volt, Elec. Mach. syn.
75 HP, 900 RPM, 220 volt, Fairbanks Morse, slip ring.
75 HP, 900 RPM, 440 volt, GE, sq. cg.
1—75 HP, 720 RPM, 440 volt, Westghse, slip ring.
1—75 HP, 720 RPM, 440 volt, GE, sq. cg.
1—50 HP, 900 RPM, 440 volt, GE, slip ring.
1—50 HP, 900 RPM, 440 volt, GE, sg. cg.

MOTORS—D.C. 230 VOLTS

2—450 HP, 400 RPM, GE
1—250 HP, 760 RPM, Electro Dynamic.
1—150 HP, 750 RPM, Electro Dynamic.
2—150 HP, 400/550 RPM Westinghouse, type SK
1—125 HP, 600 RPM, Westinghouse, SK.
1—100 HP, G.E., 575 RPM.
1—100 HP, 625 RPM, G.E.
1—65 HP, 1000 RPM, G.E., type RC.
1—50 HP, 750 RPM, Westinghouse, type SK.
1—50 HP, 700 RPM, Crocker Wheeler.
1—40 HP, 775 RPM, Westinghouse.

TRANSFORMERS

2—400 KVA, G.E., 4156-240/480 v., Scott taps.
3—300 KVA, Pittsburgh, 7800/440 volts.
3—250 KVA, GE, 6600/2200 volts, 220/440 volts
1—200 KVA, Pittsburgh, 7800-110/220 volts.
3—200 KVA, General Electric, 2200-220/440 volts.
3—150 KVA, G.E., 33,000 2300/4000 Y.
3—100 KVA, Westinghouse, 11,430/250 volts.
1—100 KVA, Pittsburgh, 1375/2750-110/220 volts.
3—100 KVA, Westinghouse, 13200 250 volts.
3—100 KVA, General Electric, 2200-220/110 volts.
3—75 KVA, G.E., 13,500-7500/440 volts.
1—75 KVA, G.E., 3 phase, 4156Y-120/208Y.
1—75 KVA, Pittsburgh, 7600-110/220 volts.
3—50 KVA, Wagner, 4150-220 volts.
2—50 KVA, Pbgh. 7500/15,000 volts-110/220 volts.
4—37½ KVA, 2200-220/110 v.
7—25 KVA, Westg., air cooled, 440/220-110 v.
1—25 KVA, G.E., 220/110-220/110 volts.
2—15 KVA, G.E., 2300-115/230 volts.

MOTORS—VARIABLE SPEED 230 VOLTS

2—100 HP, 475/1375 RPM, Electro Dynamic.
1—90 HP, 470/940 RPM, General Electric.
1—60 HP, 600/1200 RPM, General Electric.
1—35 HP, 500/1500 RPM, Westinghouse.
1—30 HP, 225/900 RPM, Crocker Wheeler.
2—25 HP, 300/900 RPM, Electro Dynamic.
1—20 HP, 750/1500 RPM, General Electric.
1—15 HP, 300/1200 RPM, G.E.
1—13/18 HP, 350/1200 RPM, Electro Dynamic.
2—11½ HP, 500/1500 RPM, Westinghouse, type SK
1—5 HP, 600/1200 RPM, General Electric.
1—5 HP, 450/1800 RPM, Crocker Wheeler.
1—5 HP, 400/1600 RPM, Diehl.
1—5 HP, 225/900 RPM, Electro Dynamic.

INSTRUMENTS

25—Westinghouse type U recording ammeters with split core CT.
25—Westinghouse type U recording voltmeters.

TURBO GENERATORS

600 KW Terry dual bleeder condensing Turbine only.
1—500 KW, G.E., 3 ph., 60 cy., 480 volt, bleeder.
1—375 KVA, Westinghouse, non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 volt, cond.
1—200 KW, G. E., 3 ph., 60 cy., 220 volt, cond.

OIL CIRCUIT BREAKERS

1—3000 amp., 15,000 v., 3 pole, G.E., type FK-130.
1—3000 amp., 600 v., 4 pole, G.E., type FK-24.
1—1600 amp., 7500 v., 4 pole, Westg., B-2.
1—1200 amp., 15000 v., 4 pole, Westg., B-2.
Also complete stock of small sizes.

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General Electric and Westinghouse 1500 and 1000 K.W., 25 cycle, direct current Rotary Converters.

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General Electric and Westinghouse 1000, 750, 500 and 300 K.W., 60 cycle, direct current, Rotary Converters.

Full Switching for All These Converters

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3—50 Ton General Electric locomotives, 600 volt direct current. Excellent Condition.

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Power Equipment

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Service backed by 38 years' experience

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Rotary Converters—3 Ph. 60 Cy.				
1—1500	Whse.	720	650	11500
1—1250	G.E.	720	250	2300
1—1000	Whse.	900	600	2300
2— 750	Whse.	1200	600	2300/4000
1— 300	G.E.	1200	600	13200
Rotary Converters—3 Ph. 25 Cy.				
2—1500	G.E.	500	225/275	6600
1— 500	G.E.	750	225/275	6600
M.G. Sets—3 Ph. 60 Cy.				
1—1500	G.E.	720	600	6600
1— 500	G.E.	720	600	13200

BELYEA COMPANY, INC.
51 Howell Street, Jersey City, N. J.

Buying
Good Used Equipment

is frequently the difference between having needed equipment or doing without it.

This
NEWSPAPER
advertisement was published in Washington, New York and Chicago by McGraw-Hill, to make friends for business.
U.S. WAR BONDS
U.S. WAR BONDS

What will TODAY'S WORK *buy* TOMORROW?

Help all understand the Value of Seed Money

Excerpt from an editorial in
INDUSTRIAL MARKETING
June, 1943

"ONE of the most interesting advertising campaigns that has been appearing in the public press* is the Seed Money series by McGraw-Hill Publishing Company. And as a by-product it has demonstrated how closely advertising with a message is read, because it is constantly being referred to in general conversation and by speakers. In fact, it has injected a new term into the vocabulary and understanding of the American people.

"Another good feature of the campaign is that it is not selfish. It is doing a job for both industry and labor. The formula it offers for putting human nature to work most effectively points directly at the shortcomings of labor and management alike and suggests united effort to protect and foster their mutual interests and the nation as well.

"The gospel of Seed Money and the objective of this campaign should be carried to every person in this country. By the provision of free mats, and handy booklet reprints at nominal cost, every industrial advertising man has available a public relations campaign which would be a credit to any organization."

•

For free newspaper mats of the accompanying Seed Money advertisement, with space for your company signature, write Research Dept., McGraw-Hill Publishing Company, Inc., 330 West 42nd St., New York (18), N. Y.

•

*McGraw-Hill publishes the Seed Money series in New York, Washington and Chicago newspapers, as well as in 22 McGraw-Hill publications.

THE nice thing about War Bonds is that there are two thrills in every dollar . . . one now and one later, when your money comes back to you with interest.

It's nice to think about that later thrill; so nice that people have given the thought a high sounding name. It's called "Post-war Planning."

When people look at their War Bonds, they don't see paper and ink. They see filling stations brimming with gasoline, super-duper new automobiles, and freedom from wanting new tires. They see new refrigerators, new rugs and air conditioned homes. They see children in college.

That is the right way for civilians to think in war. It makes them impatient to get the damned thing over with, and that speeds production.

Since personal "Post-war Planning," stimulated by a nice fat package of War Bonds, is one of the few helpful pleasures you can enjoy these days, maybe you would like to add a practical touch by thinking about *post-war prices*.

You will want to buy a lot of stuff after the war. So will everybody else. The competition to buy can send prices up, and the second thrill in your War Bond dollar will cool with every price rise.

Of course you don't want prices to skyrocket after the war. You'll holler your head off to Congress if they do.

► However, a little foresight will do a lot more good. You *can* help hold down post-war prices. You can do it by helping to create a better understanding among your friends (and among your representatives in Congress) of the only way to have low prices and high wages at the same time.

To be a practical post-war dreamer, you must un-

What will TODAY'S WORK *buy* TOMORROW? (cont'd)

stand prices. To understand prices, you must cut ough a jungle of words, laws, theories and bureaus to e bed-rock facts:

Prices will depend upon the time it takes to make, tribute and deliver the things you will want to buy. The shorter the time, the lower the price.

That's why machinery and mass production methods o important in American life.

If machines and methods are constantly improved, e and more people can have good living—because es can be high and prices low.

It's so simple that you wonder why so few people erstand it.

Not all business men understand it, for there are sands upon thousands of old machines in this coun- that are obsolete. Obsolete machines hold down es and keep prices high.

Not all labor unions understand it, because some of n think the slower a job is done the more pay labor es. That isn't true. Slow work makes high prices, high prices mean fewer people can buy the products bor.

Government understands the need for constantly roved machines, least of all. If you want proof, just at the hundreds of tax laws and other government lations that gum up the works, so far as industrial nsion is concerned.

If government, and labor and management can work a method of cooperating to equip every workman h the best possible machines and methods for short- g the time it takes to make things, your War Bonds buy more and everybody will be better off.

How can this cooperation be secured? We know agement is willing. We believe most labor leaders willing. Government acts only in response to public ion, and that means you.

You can help, first of all, by understanding why ustrial Progress is the source of all good living;" nd, by letting your representatives in Congress w that you believe government should foster and lop the constant improvement of American industry.

Government cannot help industry take care of its -war task of paying good wages, hiring back millions rkers, paying off the war debt, and keeping prices down, unless government people change their attitude toward business profits.

Business profits are the only source of industrial improvement and expansion. We built our great industries through plowing back profits in constant improvement.

► Profits that are plowed back into a business are called "Seed Money."

Seed Money pays for research, for better production methods and for IMPROVED MACHINES.

Industry will need at least as much money to get out of war production as it needed to get in.

Right now, Industry is producing the profits that could be the Seed Money for getting back into peacetime production. But government is draining off far too much of this Seed Money in taxes.

We think government puts excessive taxes on business profits because government does not understand that Industrial Progress is the Source of ALL Good Living.

If you want your War Bonds to buy more when the time for buying comes, ask your Congressman to work for a new government attitude of helpfulness toward America's greatest asset—its industrial management and skilled industrial workers. Remind your Congressman that:

"Industrial Progress
is the Source of all Good Living."

THE McGRAW-HILL NETWORK OF INDUSTRIAL COMMUNICATION

22 publications, which gather "war-news" from the "war-production-front" through a staff of 153 editors and 725 engineer-correspondents . . . More than 1,500,000 executives, designers, production men and distributors use the editorial and advertising pages of these magazines to exchange ideas on war-production problems.

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Publishers of technical, engineering and business books for colleges, schools, and for business and industrial use.

This advertisement is available in handy booklet form. (Less than 100 copies free. Larger quantities, $1.00 per 100; $10.00 per 1000.)

McGRAW-HILL

PUBLISHING COMPANY, INC. : : : BOOK COMPANY, INC.

330 WEST 42ND STREET, NEW YORK (18), N. Y.

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★ **These companies have supplied additional buying information on their products in the 1943 edition of the Electrical Buyers' Reference**

When a Switchboard has all these

Installation view of 440-volt, withdrawal-type Multumite switchboard with overhead, enclosed bus designed and fabricated by I-T-E. Length 64 feet, housing 52 circuit breakers.

WELDED STEEL FRAME
—a rigid steel structure for strength and alignment.

FLANGED DOORS
—formed and welded into sturdy members. Panels at sides, top and back are made the same way.

GRILLE-TYPE LOUVERS
—for better ventilation per square inch of opening.

BONDERIZED STEEL
—metal treated so that finish withstands severe service without cracking or peeling.

12 FINISHING OPERATIONS
—cleaning, spray-priming, then baking; then two sprays and two bakes. Pneumatic sanding prepares for two coats of enamel, both baked.

SELF-ALIGNING SEPARABLE CONTACTS
—for dependable service with least loss. No springs in current path; no pigtails.

ROTARY-TYPE HANDLES
—for fast safe operation of enclosed circuit breakers.

CONCEALED HINGES
—offering 100-degree opening of doors.

it's MULTUMITE

Design and construction features characteristic of Multumite air switchgear are incorporated as standard I-T-E practices.

I-T-E manufacturing is set up to perform all the operations with the skill and speed that standard practices bring with them.

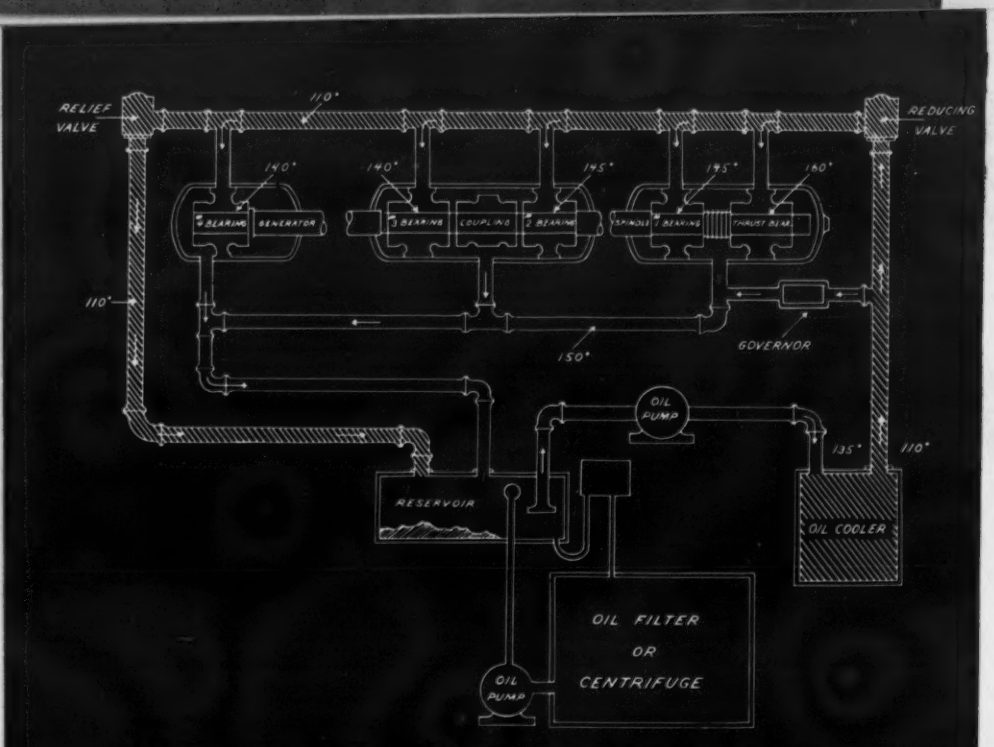
Careful planning of processing and assembly operations enables I-T-E to build air switchgear at the speed required under the pressure of war needs without omitting any of the Multumite features.

I-T-E AIR SWITCHGEAR

IMMERSED IN AIR • ENCASED IN STEEL

Representatives in Principal Cities

I-T-E CIRCUIT BREAKER CO., PHILADELPHIA, PA.



Turbine temperature variations . . . Figures given are illustrative rather than actual. They indicate temperature variations that may exist in a typical turbine lubrication system. Oil decreases in ability to hold solids in solution and allows deposits to settle out in the cooler parts, indicated by ▨ shaded areas.

Turbine Oil Sludge —a cause and cure

• BASIC CAUSE of sludge is a "thirst" for oxygen on the part of certain petroleum hydrocarbons. When they get it, they form asphaltenes or acids.

The presence of asphaltenes may not become immediately apparent, because of their solubility in hot oil. But as their concentration increases, they can no longer all be held in solution. Also, some of them become less oil-soluble because of chemical changes. Eventually they deposit in the cooler parts of the turbine, such as oil coolers, pump screens, oil lines and filters. Deposits also occur at points of low velocity, such as in governors, bearing pedestals, and where centrifugal force operates, as in couplings. Sludge is composed, in part, of these deposits.

The acidic substances also end up in the sludge, but first they gradually attack the metal in the system to form metallic soaps. From this point, you find the same pattern as with the asphaltenes—solubility in hot oil . . . increasing concentration of soaps . . . decreasing solubility . . . deposits in cooler parts . . . sludge.

Obvious answer. It is evident that sludge trouble can be minimized by removing or neutralizing the two principal types of substances which cause it. The acid-forming hydrocarbons cannot be removed by any process we know of, but they can be held in check if natural oxidation inhibitors are left in the oil. Unfortunately, the same process that removes the asphaltene-formers also takes out the natural inhibitors.

Therefore, conventional turbine oils are a compromise . . . some of the asphaltene-formers are removed, but not so many as to remove all the natural inhibitors.

Nonpareil is different. We take out *all* the asphaltene-formers . . . even though the natural inhibitors go out with them. To *restore* these, we add a patented inhibitor . . . which renders the acid-formers harmless. Thus, Nonpareil becomes the one turbine oil without asphaltene-formers and with the acid-formers neutralized.

Guaranteed in writing. A clue to Nonpareil's remarkable freedom from sludge is its low acidity in service. Accurate records on hundreds of turbines, after 10 to 15 years of operation, show that Nonpareil's acidity (as expressed by neutralization number) may be expected to be about 0.05—without batch treatment, resting or replacement. In fact, Nonpareil is sold with our written guarantee that its neutralization number will never exceed 0.15 for the life of your turbine. Use Nonpareil and your turbine-cleaning days are over.

Get all the facts. A Standard Lubrication Engineer will gladly furnish details, service records, and further proof. Phone, or write your nearest Standard Oil Company (Indiana) office, or 910 S. Michigan Ave., Chicago, Ill. In Nebraska, address Standard Oil Company of Nebraska at Omaha.

NONPAREIL TURBINE OIL

Oil Is Ammunition . . . Use It Wisely

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

★ LUBRICATION ENGINEERING